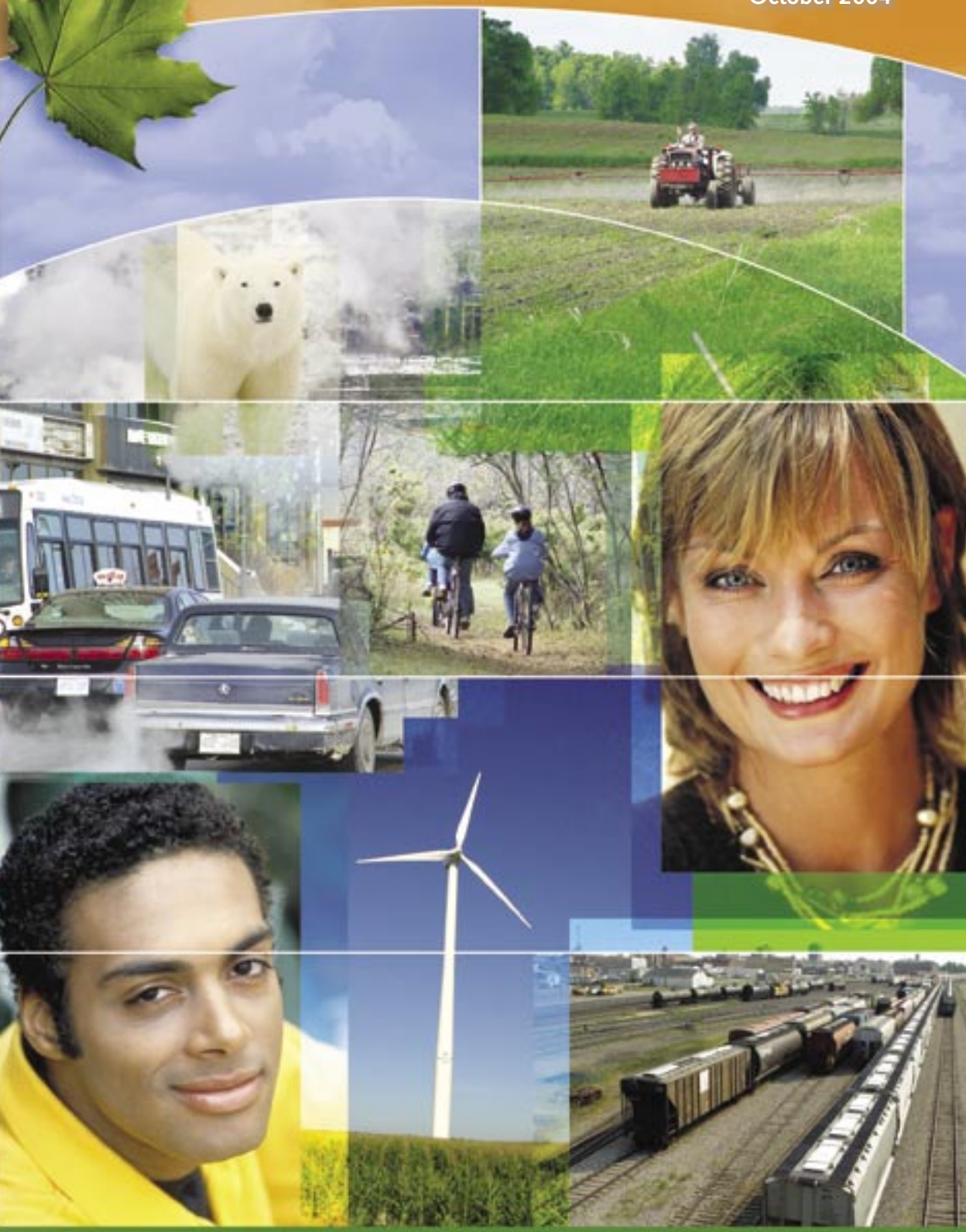
GHG Trends Information from Environment Canada's Greenhouse Gas Division

Canada's Greenhouse Gas Inventory

Overview 1990–2002

October 2004



Environment Canada Environnement Canada

Canada

Canada's Greenhouse Gas Inventory

As a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), Canada is obliged to submit an inventory of its greenhouse gas (GHG) emissions to the UNFCCC on an annual basis. Canada's GHG inventory for 2002 was submitted to the UNFCCC on April 15, 2004, as set out in the requirements. The national inventory report (NIR) is developed, compiled and reported annually by the GHG Division of Environment Canada in accordance with the UNFCCC requirements, particularly Decision 3/C.P. 5 and 18/C.P. 8, which states that Annex 1 parties should annually submit, by April 15, national inventories in accordance with the UNFCCC Guidelines on annual inventories (UNFCCC/CP/2002/8).

Inventory estimates are determined by methods and models developed in-house by engineering and scientific staff, as well as from published data, data developed by industry, or methods developed by the Intergovernmental Panel on Climate Change (IPCC, 1997). The year 2004 marks the ninth year that Canada has published a GHG emissions inventory, and this is the second inventory since Canada's decision to ratify the Kyoto Protocol in December 2002.

The GHGs that have been estimated in the national inventory are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs).

The inventory uses an internationally agreed-to reporting format that groups emissions and removals into the following six sectors: Energy, Industrial Processes, Solvent and Other Product Use, Agriculture, Land-Use Change and Forestry, and Waste.

In 2002, Canadians contributed about 731 megatonnes of carbon dioxide equivalent (Mt CO_2 eq.) of GHGs to the atmosphere[1], an increase of 2.1% over the 716 Mt recorded in the year 2001. Although Canada's GHG emissions increased during 2002, the rate of economic growth continues to outpace the rate of growth in emissions (see table p. 2).

Since the beginning of the Kyoto baseline year of 1990, the economy has grown by more than 40 percent (based on GDP), compared to a 20 percent increase in GHG emissions. As a result, we have seen a decrease in GHG intensity[2] of about 14% since 1990 while total domestic energy consumption increased 20%, and population rose 13%.

1 Unless otherwise indicated, all emission estimates given in Mt represent emissions of GHGs in Mt CO_2 equivalent. For brevity, this has been shortened to Mt. This concept provides a relative measure of the impacts of different greenhouse gases on global warming, with the effect of carbon dioxide being equal to one.

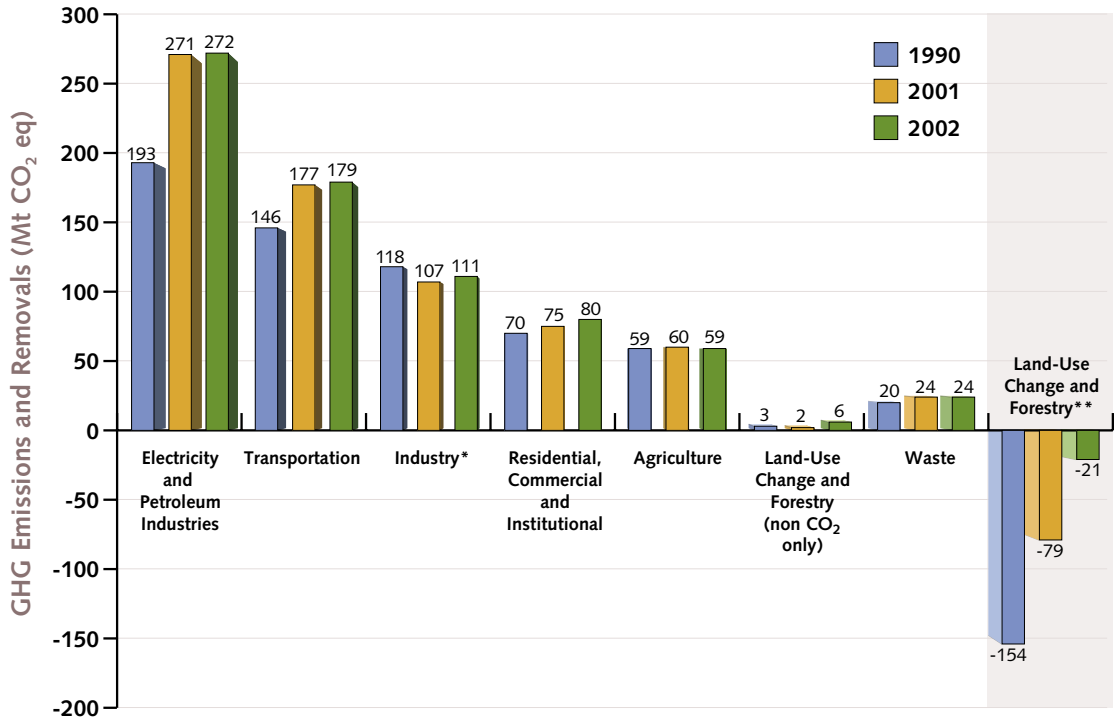
2 GHG intensity is a measure of the amount of GHGs per unit of economic activity (total GHG emissions divided by total GDP).

In addition:

- Approximately 74% of total GHG emissions in 2002 resulted from the combustion of fossil fuels. Another 8% were from fugitive sources, with the result that over 81% of emissions were from the Energy Sector.
- On an individual GHG basis, carbon dioxide contributed the largest share of 2002 emissions, at 78.8% (about 576 Mt), while methane accounted for 12.9% (94 Mt). Nitrous oxide accounted for 7.2% of the emissions (53 Mt), perfluorocarbons contributed 0.7% (5 Mt), and sulphur hexafluoride and hydrofluorocarbons constituted the remainder.
- The greatest contributions to emissions in 2002 were from the Electricity and Petroleum Industries, which accounted for 37% of total national emissions (272 Mt), and the Transportation Sector, which contributed 25% (179 Mt). These sectors are also responsible for nearly all of the growth in Canadian emissions since 1990. This growth is mainly the result of an increase in fossil fuel consumption for electricity generation, a rise in transportation energy consumption, and growth in fossil fuel production (largely for export).
- The Industry Sector posted a 6% decrease in emissions between 1990 and 2002, despite significant increases in sector GDP and production. The decline in emissions is largely a result of a decline in process emissions from adipic acid production, increased energy efficiency and fuel substitution.
- Other sectors such as Residential, Commercial and Institutional, Agriculture, and Waste contributed 11% to total emissions growth over the period.
- Net carbon dioxide removals in the Land-Use Change and Forestry Sector have declined since 1990 to an estimated 21 Mt in 2002, but are not included in the national inventory totals.

FIGURE 1

Canadian GHG Emissions and Removals, 1990, 2001 and 2002



* Value illustrated includes emissions due to *Solvent and Other Product Use*.

** Carbon dioxide emissions from the Land-Use Change and Forestry Sector are not included in the national inventory totals.

National Trends

Although Canada's GHG emissions increased during 2002, the rate of economic growth continues to outpace the rate of growth in emissions.

The 1990–2002 data on Canada's GHG emissions demonstrate progress in reducing emissions in many areas of the economy, but also indicate areas where more efforts need to be undertaken. Table 2 summarizes Canada's GHG emissions by sector for the period 1990–2002. Total emissions of all GHGs in 2002 were 20.1% above the 1990 level of 609 Mt. Although emissions have been rising since 1990 (Figure 2), annual emission growth peaked at over 5.7% in 1994. Between 2001 and 2002, emissions increased by 2.1%, following on the previous year's 1.2% emissions decrease. This growth in emissions appears to be mainly the result of increased energy exports and fossil fuel consumption for heating in the residential and commercial sectors stemming from cooler winter temperatures compared with 2001, as well as increases in the transport, and mining and manufacturing sectors. The average annual growth of emissions over the 1990–2002 period was 1.7%.

Year	Annual Growth in GHG Emissions (%)	Annual Growth in GDP* (%)
1991	-1.0%	-2.1%
1992	2.5%	0.9%
1993	1.0%	2.3%
1994	5.7%	4.8%
1995	2.4%	2.8%
1996	0.0%	1.6%
1997	1.1%	4.2%
1998	2.6%	4.1%
1999	0.6%	5.5%
2000	2.9%	5.3%
2001	-1.2%	1.9%
2002	2.1%	3.3%

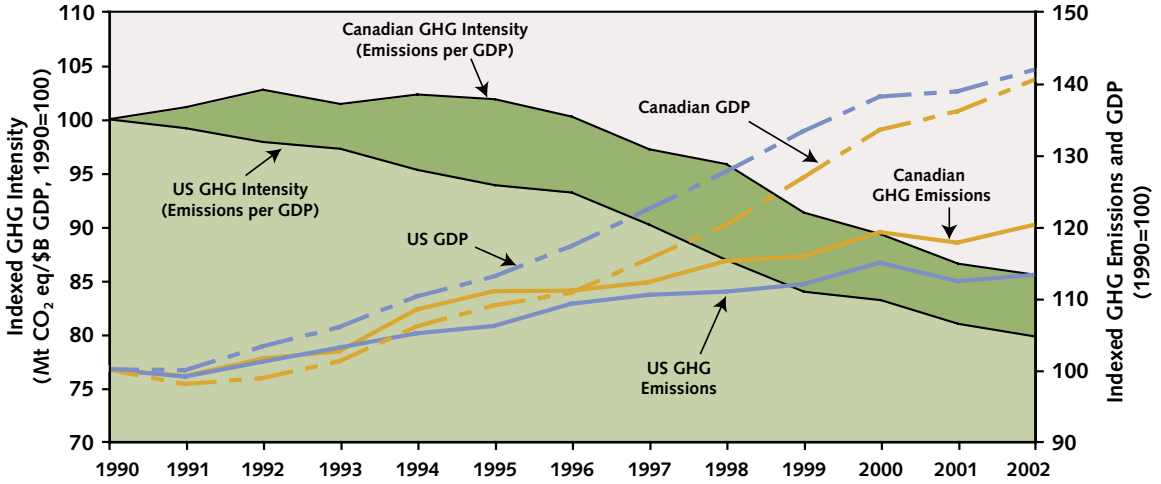
*Statistics Canada, Table 384-0002.

Figure 2 compares the trends in GHG emissions, GDP, and GHG intensity for Canada and the United States between 1990 and 2002. Both countries experienced a reduction in GHG intensity over the period. For example, Canada's GHG emissions per unit of GDP decreased by 11.5%, while the U.S. registered a 17.4% reduction. It must be noted that a reduction in GHG intensity does not necessarily reflect a reduction in emissions; it can also indicate changes in the structure of the economy. A closer examination of the trends in emissions and GDP for the two countries reveals that Canada's emissions are growing faster while our GDP is growing at a slower pace than that of the U.S. Factors that affected Canadian emissions growth included increases in fossil fuel consumption for electricity generation, increased energy consumption in the Transportation Sector, and growth in fossil fuel production (largely for export).

In fact, growth in oil and gas exports (primarily to the U.S.) contributed significantly to emissions growth between 1990 and 2002 (Table 1). In this period, total energy from crude oil and natural gas production increased 59%, and gross energy exported from these sources increased 146%, while emissions associated with those exports increased 154%. Emissions from all oil and gas production, processing and transmission activities that are attributable to gross exports accounted for over 35% of the total increase in Canada's GHG emissions over the period 1990–2002, increasing from 28 Mt in 1990 to 71 Mt in 2002.

FIGURE 2

Trends in GHG Emissions, GDP and GHG Intensity for Canada and the United States, 1990 to 2002



Sources:

Canadian GHG: Environment Canada, *Canada's Greenhouse Gas Inventory 1990–2002* .
Canadian GDP: Statistics Canada, CANSIM II, Table: 384-0002.
US GHG: US EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2002* (May 2004).
US GDP: BEA 2002.

Sector Trends in Canada's GHG Emissions and Removals: 1990 to 2002

Electricity and Petroleum Industries

- The Electricity and Petroleum Industries contributed 272 Mt, or 37% of Canada's GHG emissions in 2002. GHG emissions grew by about 42% on a sector basis, with electricity emissions increasing by 35% and petroleum industry emissions increasing by 47% since 1990.
- In 2002, the electricity industry contributed 129 Mt (18%) to Canada's GHG emissions.
  - Since 1990, electricity generation has increased by about 24% and emissions have grown by 35%, due primarily to the increased use of coal.
- In 2002, the petroleum industry as a whole contributed 143 Mt (about 20%) of Canada's GHG emissions, of which the upstream and downstream petroleum sectors contributed 115.7 Mt and 27.6 Mt, respectively.
  - As a result of increased foreign demand, the petroleum industry has experienced a 42.9 Mt (154%) increase in GHG emissions since 1990. Increased demand for crude oil and natural gas resulted in 202% growth in net energy exports and 39.6% growth in GDP.

TABLE 1

Energy Production, Export and GHG Emission Trends, 1990 to 2002

	Year			
	1990	2001	2002	Long-Term Trend (1990–2002)
GHG Emissions[1] (Mt CO_2 eq)	609	716	731	20.1%
GDP[2] - Expense (Millions of 1997$)	765,311	1,040,388	1,074,516	40.4%
Domestic Energy Consumption[3] (PJ)	9,230	10,950	11,076	20%
Energy Production[3] (PJ)	7,752	11,949	12,336	59%
Energy Exported[3] (PJ)	3,050	7,291	7,515	146%
Net Energy Exported[3] (PJ)	1,755	4,962	5,294	202%
Emissions Associated with Exports[4] (Mt CO_2 eq)	28	68	71	154%
Emissions Associated with Net Exports[4] (Mt CO_2 eq)	22	48	51	138%

Sources:

1 Environment Canada, *Canada's Greenhouse Gas Inventory 1990–2002*.

2 Statistics Canada, CANSIM II, Table: 384-0002.

3 Statistics Canada, Catalogue # 57-003.

4 For years 1990 to 1995, values were taken from McCann, T.J. et al. *Fossil Fuel Energy Trade & Greenhouse Gas Emissions: A Quantitative Assessment of Emissions Related to Imports and Exports*, Prepared for Environment Canada, 1997. Years 1996 to 2001 values were extrapolated from the report.

- Since 1990, the upstream petroleum industry has experienced a 41.6% growth in GDP and a 56% (41.7 Mt) increase in GHG emissions.
  - Increasing foreign energy demands resulted in a 29.6 Mt increase in GHGs from the upstream petroleum industry.
  - Since 1990, emissions from the transmission of natural gas increased by 5.4 Mt (48%), while GDP for this sub-sector grew by 95%. Between 2001 and 2002, combustion emissions from natural gas pipelines increased by 0.6 Mt (5.8%) due to a 7% increase in domestic demand.
- Since 1990, the downstream petroleum industry has experienced a 30.2% growth in GDP with a 17% increase in GHG emissions.
  - Refining of petroleum products contributed 24.2 Mt through combustion and process emissions, while fugitive emissions from the distribution of natural gas contributed 3.4 Mt

Transportation

- The Transportation Sector (excluding Pipelines) represents one of the largest sources of emissions in Canada, accounting for 24.5% of Canada's total emissions in 2002 (179 Mt).
- Emissions increased 23% (33.2 Mt) between 1990 and 2002. On-road transportation was the largest contributor to emissions in this sector, at 76.5%. Nearly all emissions growth can be attributed to light-duty gasoline trucks

(LDGTs – this includes sport utility vehicles (SUVs) and minivans), which contributed 58% or 19.2 Mt of this sector's growth, and heavy-duty diesel vehicles, which accounted for 45% or 15.0 Mt of the growth. Figure 3 provides a breakdown of emissions from the different modes of transportation.

- Over the short term (2001–2002), most regions exhibited transportation-related changes that saw diesel-based emissions decrease. This resulted mainly from decreased shipping associated with reduced manufacturing output. The long-term trend (1990–2002) shows an increase in emissions from light-duty gasoline trucks, while emissions from light-duty gasoline automobiles (or cars) are decreasing. This can be explained by the increase in the number of cars on Canadian roads and people purchasing LDGTs (SUVs, minivans) instead of cars. However, in the short term, between 2000 and 2002, car emissions have increased by 4% (2 Mt). Domestic aviation emissions in general have increased since 1990, except for 2001 when there was a decrease. Between 2001 and 2002, domestic aviation emissions increased, but they are still 2.5% (0.5 Mt) below the 2000 emissions level. The change in car and domestic aviation emissions in 2001 is probably due to the events of September 11, 2001, which caused an increase in ground transportation and a decrease in air transportation.

FIGURE 3

Canada's GHG Emissions from Transportation Sources in 2002

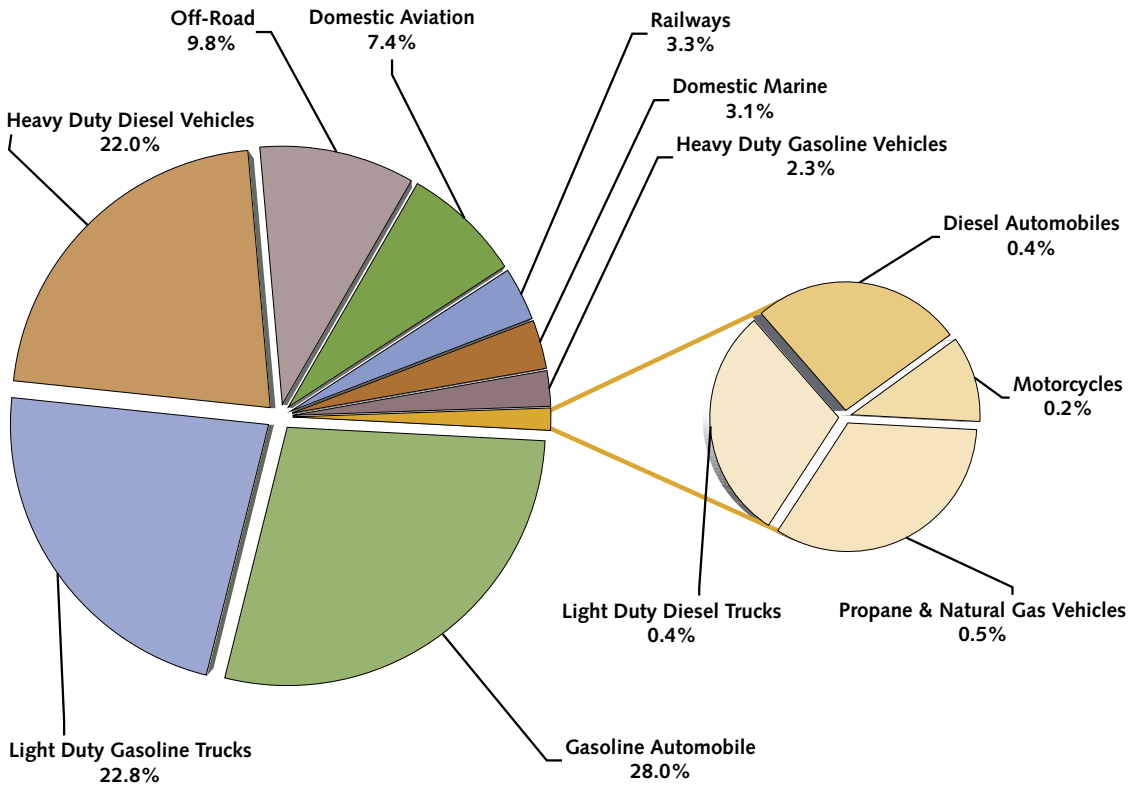


TABLE 2

Canada's GHG Emissions Summary by Sector, 1990, 2001 and 2002

Greenhouse Gas Categories	Mt CO_2 equivalent		
	1990	2001	2002
TOTAL	**609**	**716**	**731**
Electricity & Petroleum Industries	**193**	**271**	**272**
Electricity Generation[1]	95	134	129
Upstream Oil and Gas[2]	63	97	99
Upstream-Natural Gas Transmission	11	16	17
Petroleum Refining[3]	21	20	24
Downstream-Natural Gas Distribution	3	3	3
Transportation	**146**	**177**	**179**
Domestic Aviation	11	12	13
Gasoline Automobile	54	49	50
Light Duty Gasoline Trucks	22	39	41
Heavy Duty Gasoline Vehicles	3	4	4
Motorcycles	0.2	0.2	0.3
Diesel Automobiles	0.7	0.6	0.7
Light Duty Diesel Trucks	0.6	0.7	0.8
Heavy Duty Diesel Vehicles	25	39	40
Propane & Natural Gas Vehicles	2.2	1.1	0.9
Railways	7	7	6
Domestic Marine	5	6	5
Off-Road	17	19	18
Industry	**118**	**107**	**111**
Mining[4]	7	10	11
Smelting and Refining Industries	17	16	16
Pulp and Paper and Sawmills	14	10	9
Primary & Other Steel Industries	14	13	14
Cement	9	10	10
Industrial Chemical Production	28	19	19
Other Manufacturing	25	26	27
Other Industries	4	3	3
Solvent & Other Product Use	0.4	0.5	0.5
Residential, Commercial & Institutional	**70**	**75**	**80**
Commercial & Institutional	26	33	36
Residential	44	42	44
Agriculture	**59**	**60**	**59**
Enteric Fermentation	16	19	19
Manure Management	8	10	10
Agriculture Soils-Direct Sources	29	24	23
Agriculture Soils-Indirect Sources	5	7	7
Land Use Change and Forestry (non-CO_2 only)[5]	**2.9**	**2.0**	**6.0**
Prescribed Burns	0.7	0.2	0.5
Wildfires in the Wood Production Forest	2.2	1.8	5.5
Waste	**20**	**24**	**24**
Solid Waste Disposal on Land	19	22	22
Wastewater Handling	1.2	1.4	1.4
Waste Incineration	0.3	0.4	0.4
Land Use Change and Forestry[5]	**-154**	**-79**	**-21**

Figures are rounded to reflect the uncertainty in the estimates.

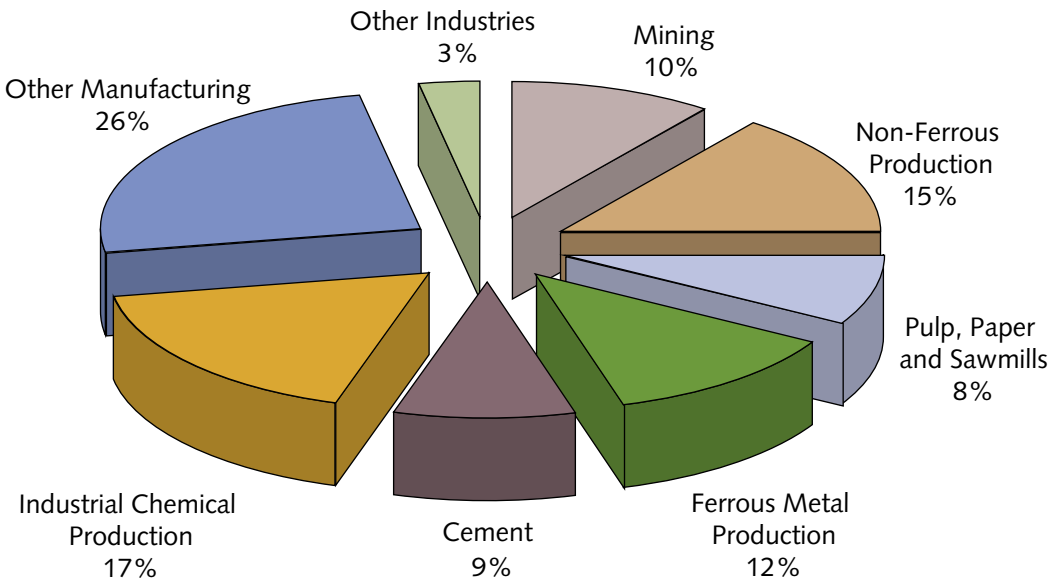
1 Includes both utility and industrial generation, and commercial steam generation.
2 Includes combustion, process and fugitive emissions associated with conventional and unconventional production of oil and gas.
3 Includes combustion and process emissions associated with the refining of crude oil.
4 A small proportion of emissions from the upstream petroleum industry (NAAICS 211) is accounted for the mining sector due to data limitations.
5 CO_2 emissions and removals in the LUCF Sector are not included in the national totals. Non-CO_2 emission from fires located in the national parks are not included in the provincial/territorial totals but reported in the national totals.

Mining and Manufacturing Industries

- Mining and Manufacturing Industries together contributed 15% (111 Mt) to Canada's total GHG emissions in 2002. Of these emissions, combustion emissions accounted for almost 57% and process emissions approximately 41%. Fugitive emissions accounted for less than 1% of the emissions from this sector (1.0 Mt). It is important to note that GHG emissions from off-road vehicles in this sector are currently accounted for in the Transportation Sector and are not included here.
- As depicted in Figure 4, the other manufacturing sub-sector accounted for one quarter (27.4 Mt) of the total GHG emissions from the Industry Sector in 2002. This sub-sector encompasses all manufacturing activities not captured under any of the other specific categories in the Industry Sector. This includes food manufacturing, plastics & rubber manufacturing, and lime & gypsum products manufacturing, to name just a few. The GHG emissions in this sub-sector are primarily combustion emissions (77%), with the industrial process emissions making up the balance.

FIGURE 4

Breakdown of Canada's 2002 GHG Emissions in the Mining and Manufacturing Industries by Industrial Sub-sector



- The mining sub-sector accounted for 11.2 Mt of Canada's GHG emissions in 2002. About 90% of these emissions are combustion emissions, while the remainder are attributable to fugitive methane emissions from underground coal mines.
- The non-ferrous metal production (smelting and refining) sub-sector contributed 15% (16.5 Mt) to the Industry Sector's GHG emissions in 2002. The bulk of these emissions are due to the release of gases with high global warming potential originating from aluminum and magnesium production processes. Process emissions from this sub-sector total 13.1 Mt, with combustion emissions accounting for the balance.

Canada's Greenhouse Gas Inventory 1990–2002

Contact the Inquiry Centre at Environment Canada for further information.

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- In 2002, the ferrous metal production (iron and steel) sub-sector contributed 13.5 Mt (1.8%) to Canada's total GHG emissions. Stationary fuel combustion and process related sources accounted for 47% (6.4 Mt) and 53% (7.1 Mt) of the GHG emissions, respectively.
- As shown in Figure 4, the cement sub-sector accounted for 9% (10.2 Mt) of the total GHG emissions from the Industry Sector in 2002, with approximately two thirds of the emissions produced as a result of the clinker production process.
- In 2002, GHG emissions from industrial chemical production are estimated at 19.2 Mt, or 2.6% of Canada's national GHG emission total. Process GHG emissions again account for almost two thirds of the total emissions from this sub-sector, with combustion emissions contributing the balance. Process emissions from this sub-sector include CO_2 emissions from the steam reforming of natural gas in ammonia production and N_2O generated as a by-product during the production of adipic and nitric acids.
- Overall, the Industry Sector has experienced a 6% (6.8 Mt) decline in GHG emissions between 1990 and 2002, despite an increase in production and GDP in most of the sub-sector industries. Emissions have decreased in large part due to a significant reduction in process emissions from adipic acid production, and lower GHG emission intensities through improved energy efficiency and fuel substitution.

Residential, Commercial and Institutional Sector

- The Residential, Commercial and Institutional Sector contributed 80 Mt or 11% of Canada's GHG emissions in 2002. The residential sub-sector alone contributed about 44 Mt (6.1%), while the commercial and institutional sub-sector contributed 36 Mt (4.9%).
- Overall, emissions grew by 5 Mt (6.2%) since 1990. There was a 0.7% increase in residential and a 38.7% increase in the commercial and institutional sub-sectors. Floor space in both residential and commercial sub-sectors has increased significantly and consistently since 1990. This trend was countered by two factors: fuel substitution from refined petroleum products to natural gas and improvements in end-use efficiency. Combined, these factors have reduced energy consumption and emissions within the residential sub-sector.

Agriculture

- In 2002, Agriculture-related GHG emissions totalled 59 Mt, and contributed 8% of total national emissions. This sector accounted for 66% of Canada's total emissions of nitrous oxide and 26% of methane emissions.
- On a category basis, agricultural soils contributed 50% of the sector's emissions (29.6 Mt) in 2002. The other half came from the enteric fermentation from domestic animals (32% or 18.8 Mt) and manure management (17% or 10.2 Mt).
- While total sector emissions decreased 0.8% between 1990 and 2002, emissions from manure management rose 24% and enteric fermentation emissions increased 18%. Net carbon dioxide emissions from agricultural soils partially offset these increases, changing from a net source of 7.6 Mt in 1990 to a net sink of 0.5 Mt in 2002. Nitrous oxide emissions from soils, however, rose 10% over the same period.

Land-Use Change and Forestry (LUCF)

- The LUCF Sector was a net sink in 2002, as it removed an estimated 15 Mt from the atmosphere. This estimate represents the sum of the net carbon dioxide flux and non-carbon dioxide (methane and nitrous oxide) emissions.
- The net carbon dioxide flux alone amounted to a sink of 21 Mt; however, under current international reporting rules LUCF carbon dioxide fluxes are not included in the national inventory totals. If they were included, it would have resulted in reduction of 3% of total Canadian emissions in 2002. Non-carbon dioxide emissions, however, are included in the national totals and amounted to 6.0 Mt in 2002. Under the terms of the Kyoto Protocol, sources and sinks from some land-use change and forestry activities could be included and accounted for separately during the first commitment period (2008–2012).
- The time series of the net LUCF flux over the 1990–2002 period is heavily influenced by the high variability in the impact of natural disturbances, notably forest fires. As a result, the LUFC Sector can be either a source (as in 1995) or a sink (as in 2002).
- If natural disturbances are excluded, the trends observed in the LUCF category largely reflect the changing levels of industrial forestry activity during the 1990s; by including the carbon stored in harvested wood products in the calculations, it would significantly reduce the apparent impact of industrial activity on LUCF emissions and removals.
- The natural variability of forest fires remains a major source of uncertainty in estimates of annual emissions and of projections of these emissions in the future.
- Additional uncertainty in net forest removals is introduced by the omission of significant ecosystem carbon pools, notably soil organic carbon and dead biomass.
- Ongoing work involving several government departments and the university research community aims to improve information sources and support the development of a comprehensive monitoring, accounting and reporting system in the LUCF Sector.

Waste

- The Waste Sector contributed 23.7 Mt or 3.2% to Canada's GHG emissions in 2002. Solid waste disposal on land accounted for more than 93% (22 Mt) of the Waste Sector's GHG emissions, while wastewater handling and waste incineration accounted for 5.9% (1.4 Mt) and 1.5% (0.4 Mt), respectively.
- In 2002, methane captured by landfill gas collection systems contributed to a 26% (7.1 Mt) reduction in direct atmospheric emissions of methane from municipal solid waste. This resulted in a net release of 20 Mt.
- Methane captured by landfill gas collection systems has increased by 33% (5.5 Mt), since 1990.

TABLE 3

Summary of Provincial and Territorial GHG Emissions by Sector, 1990 and 2002

	NL	PE	NS
1990 GHG Emissions by Sector			
Energy	8,892	1,466	17,847
Industrial Processes	77	3	276
Solvent and Other Product Use	9	2	14
Agriculture	77	408	609
Land-Use Change and Forestry	24	5	4
Waste	364	77	593
Total	**9,443**	**1,960**	**19,343**
2002 GHG Emissions by Sector			
Energy	10,846	1,546	18,819
Industrial Processes	25	2	205
Solvent and Other Product Use	8	2	14
Agriculture	42	424	600
Land-Use Change and Forestry	28	2	1
Waste	443	93	729
Total	**11,392**	**2,070**	**20,369**
Absolute Change in Emissions (kt) 1990–2002	1,949	109	1,026
Relative Change in Emissions (%) 1990–2002	21%	6%	5%
Relative Contribution to Absolute Growth in emissions (%)	NA	0.1%	0.9%
2002 GHG per capita[1] (tonnes GHG/person) (National average - 23.3 tonnes/person)	17.8	14.7	21.9
2002 GHG Intensity of GDP[2] (GHG kt CO_2 eq/ Million$GDP) National value - 0.68	0.76	0.65	0.87

Sources:

GHG Emissions: Environment Canada, *Canada's Greenhouse Gas Inventory 1990–2002.*

1 Population data: Statistics Canada, CANSIM II Table 051-0001.

2 GDP data: *Gross Domestic Product, (1997 Chained dollars) CANSIM 384-0002.*

Provincial and Territorial GHG Emissions

Table 3 provides a summary of GHG emissions by province and territory for 1990 and 2002 by sector (as defined by the UNFCCC). Although the UNFCCC Guidelines on annual inventories only require that national-level detail be reported, it is considered important to provide these details due to the distinct regional differences in emission levels and trends that exist within Canada. Also, it must be noted that provincial and territorial emission estimates do not sum exactly to the national totals. The differences are due to two factors: rounding of the emissions data and suppression of some confidential provincial activity data.

GHG emissions are not distributed evenly across Canada. Regional differences in factors such as climate, resources available for energy production and/or industry, as well as travel patterns, all contribute to different levels and trends of emissions. Figure 5 illustrates the provincial and

NB	QC	ON	MB	SK	AB	BC	NT & NU	YT
			kt CO_2 equivalent					
14,696	59,389	135,624	12,576	34,509	143,327	42,209	1,552	507
152	13,722	25,856	470	591	8,796	3,518	1	3
11	106	155	17	15	38	50	1	0
495	8,059	11,635	6,764	11,170	17,387	2,579	–	–
21	55	120	55	628	150	811	351	569
499	5,766	7,171	424	504	1,011	3,641	14	7
15,875	**87,096**	**180,561**	**20,305**	**47,416**	**170,709**	**52,808**	**1,918**	**1,085**
			kt CO_2 equivalent					
19,929	64,631	165,726	12,512	48,896	191,687	55,520	1,956	479
449	11,668	17,846	271	1,272	7,346	3,518	5	1
11	112	182	17	15	47	62	1	0
543	8,262	11,454	7,050	8,756	18,805	2,802	–	–
1	780	207	1,118	1,478	1,665	421	243	27
621	6,009	8,063	630	636	1,314	5,159	19	9
21,554	**91,462**	**203,478**	**21,599**	**61,054**	**220,863**	**67,482**	**2,225**	**516**
5,680	4,366	22,917	1,294	13,638	50,155	14,674	307	-569
36%	5%	13%	6%	29%	29%	28%	16%	-52%
4.9%	3.8%	19.8%	1.1%	11.8%	43.4%	12.7%	0.3%	-0.5%
29.9	11.6	16.7	17.3	58.9	72.0	16.1	39.3	16.1
1.17	0.39	0.46	0.60	1.92	1.78	0.53	0.73	0.42

Notes:

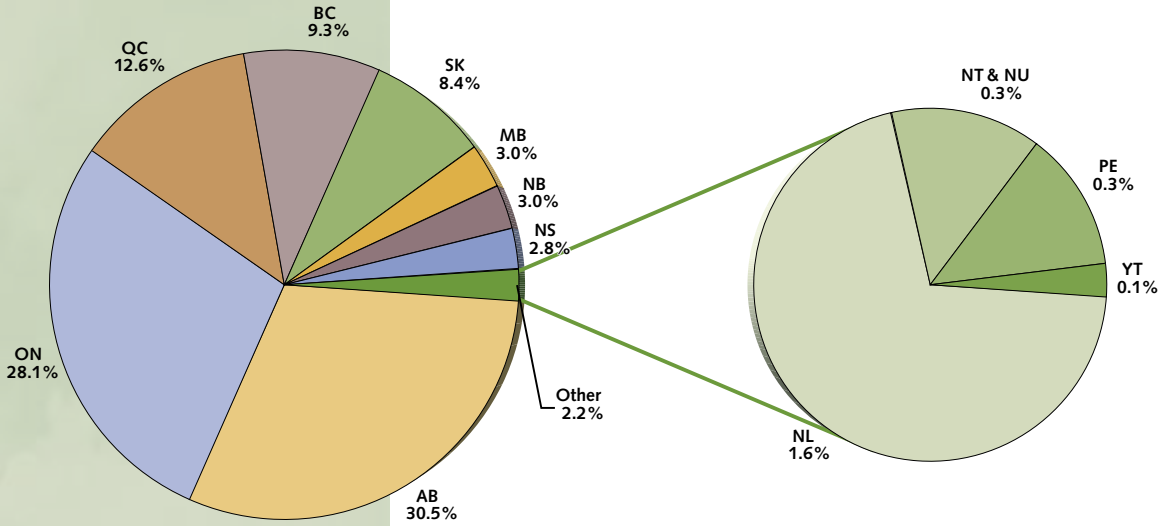
Due to rounding, individual values may not add up to totals (zero values may represent estimated quantities too small to display).

Emissions associated with the use of HFCs, PFCs, limestone and soda ash are reported in the national total.

territorial contributions to Canada's total emissions in 2002. The largest provincial contributors were Alberta, with 31% of Canada's total emissions (221 Mt), and Ontario, which accounted for 28% of the national total (203 Mt). The next largest contribution to national emissions was from Quebec, at 13%, while British Columbia and Saskatchewan contributed 9% and 8%, respectively. The remainder of the emissions in 2002 were from Manitoba, Nova Scotia and New Brunswick (each accounting for about 3%). Newfoundland and Labrador added 2%, while Prince Edward Island and the territories together contributed less than 1% to total national emissions in 2002.

FIGURE 5

Relative Provincial and Territorial Contributions to Canada's GHG Emissions in 2002



In terms of emissions growth, all provinces and territories except the Yukon (–52%) experienced an increase in their emissions over the 1990 to 2002 period. Emissions from New Brunswick rose 36%, and Newfoundland and Labrador, British Columbia, Alberta and Saskatchewan showed increases ranging between 21% and 29%. In addition, during this 11-year period four provinces were responsible for almost 90% of the total national growth in emissions – Alberta accounted for 44% of the total growth, while Ontario and British Columbia contributed 20% and 13%, respectively, and Saskatchewan added 12%.

Excluding CO_2 emissions from agricultural soils, total emissions from the Agriculture Sector increased by 15% between 1990 and 2002 (from 51.6 Mt to 59.3 Mt). On a provincial

basis, CH_4 and N_2O emissions have increased steadily from 5.6 to 7.4 Mt in Manitoba, from 8.9 to 11.5 Mt in Saskatchewan, and from 14.2 to 17.2 Mt in Alberta. There has been very little change in CH_4 and N_2O emissions in British Columbia, Ontario, Quebec and the Atlantic regions of Canada. The increased emissions from the Prairie provinces have mainly resulted from livestock expansion and higher synthetic nitrogen fertilizer consumption. Collectively, they have contributed to most of the growth in Canada's non-CO_2 GHG emissions from the Agriculture Sector since 1990. The increased non-CO_2 emissions from the Prairies are partially offset by increasing removals of CO_2 because of increasing storage of soil organic carbon through adoption of no-till and reduction of summer-fallow.

For a complete summary of provincial and territorial emissions for the years 1990 through 2002 inclusive, consult Environment Canada's Greenhouse Gas Emissions Web site at **www.ec.gc.ca/pdb/ghg**

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The Library and Archives Canada has catalogued this publication as follows:

Main entry under title:
Canada's Greenhouse Gas Inventory: Overview 1990–2002

Issued also in French under title: Inventaire canadien des gaz à effet de serre, Faits saillants 1990–2002.

ISBN 0-662-37819-9
Cat. No. En49-5/5-10-2-2002E
EPS M-547

1. Greenhouse gases – Canada – Measurement.
2. Methane – Environmental aspects – Canada.
3. Nitrous oxide – Environmental aspects – Canada.
4. Pollution – Canada – Measurement.
I. Canada. Environment Canada. Greenhouse Gas Division.

TD885.5C32 2004 363.739'74'0971

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