October 2003

CANADA'S GREENHOUSE GAS INVENTORY

GHG Trends Information from Environment Canada's Greenhouse Gas Division

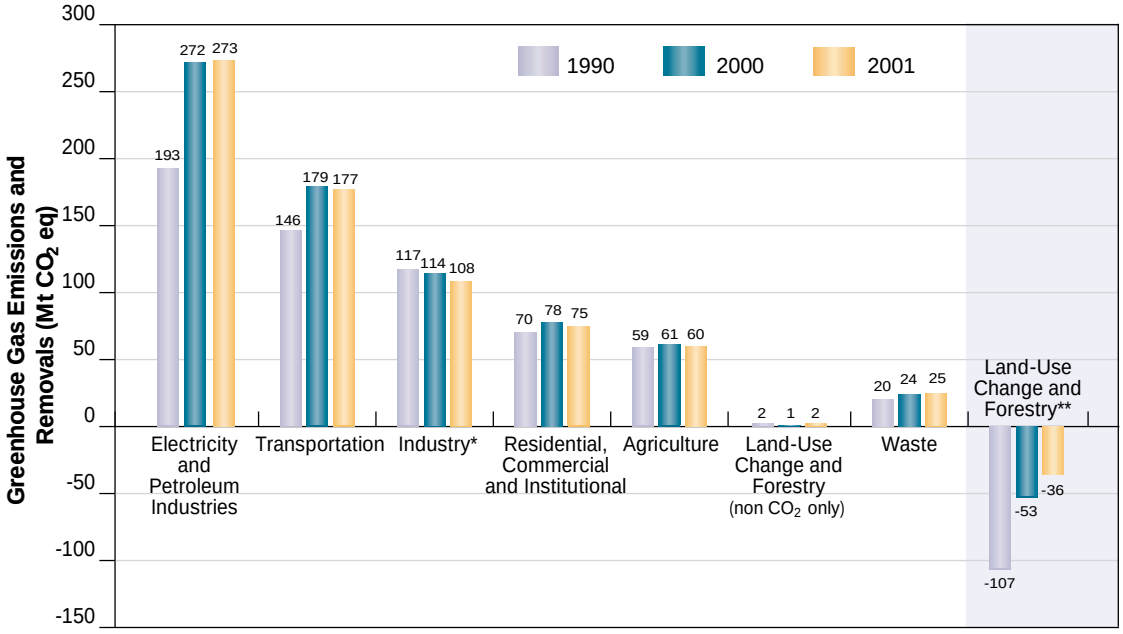
OVERVIEW: 1990-2001

In 2001, Canadians contributed about 720 megatonnes of carbon dioxide equivalent (Mt CO_2 eq)* of greenhouse gases (GHG) to the atmosphere, a decrease of 1.3% over the 730 Mt recorded in the year 2000. This is the first year-over-year emissions decrease in Canada since the economic recession of 1991. This is particularly significant for the fact that, in 2001, Canada was still experiencing good economic growth, as evidenced by a 1.5% increase in Gross Domestic Product (GDP). Between 1990 and 2001, emissions increased 18.5%, or 113 Mt, while Canada's Gross Domestic Product grew 34%, total domestic energy consumption increased 17%, and population rose 12%. In addition:

- Approximately 73% of total GHG emissions in 2001 resulted from the combustion of fossil fuels, while another 8% were from fugitive sources. As a result, over 80% of emissions were from the Energy sector.
- On an individual GHG basis, carbon dioxide contributed the largest share of 2001 emissions, at 78.9% (about 566 Mt), while methane accounted for 12.4% (93 Mt). Nitrous oxide accounted for 7.4% of the emissions (51 Mt), perfluorocarbons contributed 0.9% (6 Mt), and sulphur hexafluoride and hydrofluorocarbons constituted the remainder.
- The greatest sector contributions to emissions in 2001 were from Electricity and Petroleum Industries, which accounted for 38% of total national emissions (274 Mt), and the Transportation sector, which contributed 25% (177 Mt). These sectors are also responsible for nearly all of the growth in Canadian emissions since 1990. This is mainly the result of an increase in fossil fuel

*Unless otherwise indicated, all emissions are reported in Mt CO_2 eq. For brevity, this has been shortened to Mt. This concept provides a relative measure of the impacts of different greenhouse gases on climate change, with the effect of carbon dioxide being equal to one.

Figure 1 Canadian Greenhouse Gas Emissions and Removals, 1990, 2000 and 2001



*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.

consumption for electricity generation, a rise in transportation energy consumption, as well as growth in fossil fuel production (largely for export).

- The Industry sector posted a 9% decrease in emissions between 1990 and 2001, 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 (RCI), Agriculture, and Waste — contributed 9% to the 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 36 Mt in 2001, but are not included in the national inventory totals.

Canada's Greenhouse Gas Inventory (CGHGI)

The Canadian Greenhouse Gas Inventory is developed, compiled, and reported annually by the Greenhouse Gas Division of Environment Canada. The inventory is prepared in accordance with the United Nations Framework Convention on Climate Change (UNFCCC) requirements, particularly Decision 3/CP. 5 and 18/CP.8 which state 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). 2003 marks the 11th year that Canada has published a GHG emissions inventory and the first inventory submission since Canada's decision to ratify the Kyoto Protocol in December 2002.

The greenhouse gases 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).

Canada's Gross Domestic Product (GDP) has been growing more rapidly as greenhouse gas emission growth has slowed.

Year	Annual Growth in GHG Emissions (%)	Annual Growth in GDP* (%)
1991	-1.1%	-2.1%
1992	2.6%	0.9%
1993	0.4%	2.3%
1994	3.5%	4.8%
1995	2.7%	2.8%
1996	2.3%	1.6%
1997	1.4%	4.2%
1998	1.1%	4.1%
1999	2.5%	5.4%
2000	3.2%	4.5%
2001	-1.3%	1.5%

* Statistics Canada, Table 384-0002

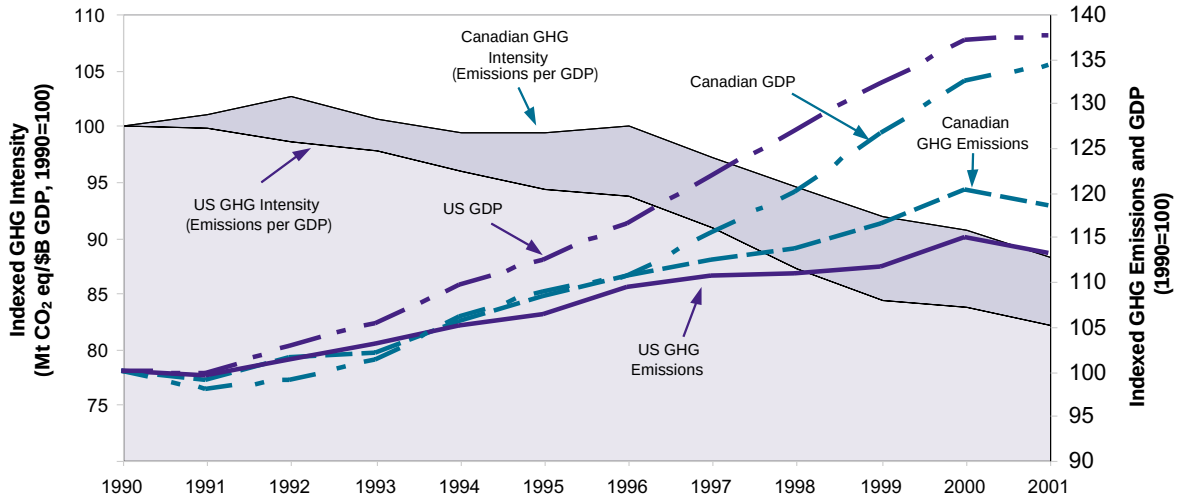
The inventory uses an internationally agreed to reporting format that groups emissions and removals into the following six sectors: Energy, Industrial Processes, Solvent and Other Product Use, Agriculture, Land-Use Change and Forestry, and Waste.

National Trends

The 1990–2001 data on Canada's GHG emissions (Table 2) demonstrates progress in reducing emissions in many areas of the economy, but also indicates areas where more work needs to be done. Total emissions of all GHGs in 2001 were 18.5% above the 1990 level of 608 Mt. Although emissions have been rising since 1990, in 1994, emission growth peaked at over 3.5% per year. It fell consistently thereafter until 1999 and 2000, when emissions rose 2.5% and 3.2% respectively. Between 2000 and 2001, emissions declined by 1.3%, representing the first decline in emissions since 1991. This decline appears to be mainly the result of a warmer than average winter, reduced energy use in some industrial sectors and a decline in transportation emissions. The cumulative average annual growth of emissions over the 1990–2001 period was 1.6%.

Figure 2 compares the trends in greenhouse gas emissions, GDP, and greenhouse gas intensity (a measure of the amount of greenhouse gases per unit of economic activity) for Canada and the United States between 1990 and 2001. Both countries experienced a reduction in greenhouse gas intensity over the period. For example, Canada's greenhouse gas emissions per unit of

Figure 2 Trends in Greenhouse Gas Emissions, GDP and Greenhouse Gas Intensity for Canada and the United States, 1990 to 2001



Sources: Canadian GHG: Environment Canada, *Canada's Greenhouse Gas Inventory 1990-2001* (in press); Canadian GDP: Statistics Canada, CANSIM II, Table 384-0002; US GHG: US EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2001* (April, 2003); US GDP: BEA, 2001.

GDP decreased by 9.3%, while the US experienced a 16.2% reduction since 1990. It must be noted that a reduction in greenhouse gas 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 individual trends in emissions and GDP for the two countries reveals that Canada's emissions are growing faster while our Gross Domestic Product is growing at a slower pace than that of the US. Factors that affected Canadian emissions growth include 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 United States) contributed significantly to emissions growth between 1990 and 2001 (Table 1). In this period, total energy from crude oil and natural gas production increased 54% and gross energy exported from these sources increased 139%, while emissions associated with those exports increased 141%. 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 greenhouse gas emissions over the period 1990-2001, increasing from 28 Mt in 1990 to 67 Mt in 2001.

Sector Trends in Canada's GHG Emissions and Removals: 1990 to 2001

Electricity and Petroleum Industries

- The Electricity and Petroleum Industries contributed 273 Mt, or 38% of Canada's greenhouse gas emissions in 2001. Greenhouse gas emissions grew by about 42%, on a sector basis with electricity emissions increasing by 44% and petroleum industry emissions increasing by 40%, since 1990.
- In 2001, the Electricity Industry contributed 137 Mt (19%) to Canada's greenhouse gas emissions.
  - Electricity generation increased by about 22% and emissions grew by 44%, due to an increased use of coal (a greenhouse gas intensive fossil fuel), since 1990.
- In 2001, the Petroleum Industry as a whole contributed 136 Mt (about 19%) of Canada's greenhouse gas emissions, of which the Upstream and Downstream Petroleum sectors contributed 113 Mt and 23 Mt, respectively.
  - Increased demand for crude oil and natural gas resulted in 139% growth in energy exports and a 40% (38.8 Mt) increase in emissions from the Petroleum Industry since 1990.

Table 1 Energy Production, Export and Greenhouse Gas Emission Trends, 1990 to 2001

Year	1990	2000	2001	Long-Term Trend (1990-2001)
Greenhouse Gas Emissions[1] (Mt CO_2 eq)	608	730	720	18.5%
GDP[2] - Expense (Millions of 1997$)	765,311	1,012,334	1,027,522	34.3%
Domestic Energy Consumption[3] (PJ)	9,230	10,830	10,836	17%
Energy Production[3] (PJ)	7,752	11,729	11,949	54%
Energy Exported[3] (PJ)	3,050	7,046	7291	139%
Net Energy Exported[3] (PJ)	1,755	4,822	4,962	183%
Emissions Associated with Exports[4] (Mt CO_2 eq)	28	66	68	146%
Emissions Associated with Net Exports[4] (Mt CO_2 eq)	22	48	48	122%

Sources: [1] Environment Canada, *Canada's Greenhouse Gas Inventory 1990-2001* (in press);
[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 experienced a 47% growth in GDP and a 53% (34.6 Mt) increase in greenhouse gas emissions due to increasing foreign energy demands (Informetrica Limited and Statistics Canada, 2003)
- The Downstream Petroleum Industry experienced 22% growth in GDP with a 1.7% decline in greenhouse gas emissions since 1990 (Informetrica Limited and Statistics Canada, 2003). As refining efficiency has improved, fuel combustion emissions from petroleum refining have decreased by 5.6% (about 1 Mt) with a 14% increase in production (CIEEDAC, 2003).

Transportation

- The Transportation sector (excluding Pipelines) represents one of the largest sources of emissions in Canada, accounting for 24.7% of total emissions in 2001 (177 Mt).
- Emissions increased 21% between 1990 and 2001. On-road transportation was the largest contributor to emissions in this sector, at 72.7%. Nearly all emissions growth can be attributed to Light-Duty Gasoline Trucks (LDGT, this includes sport utility vehicles and minivans), which contributed 44% or 14.7 Mt of this sector's growth and Heavy-duty Diesel Vehicles (HDDV), which accounted for 40% or 13.3 Mt of the growth. Figure 3 provides a breakdown of emissions from the different modes of transportation.

Mining and Manufacturing Industries

- This Industry sector contributed 15% (108 Mt) to Canada's total GHG emissions in 2001. Of these emissions, combustion emissions accounted for almost 57% and process emissions approximately 43%. 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 accounted for in the Transport sector and are not included here.
- As depicted in Figure 4, the Other Manufacturing sub-sector accounted for one quarter (26.4 Mt) of the total GHG emissions from the Industrial sector in 2001. This sub-sector encompasses all manufacturing activities not captured under any of the other specific categories in the Industrial 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 (76%) with industrial process emissions making up the balance.

Table 2 Canada's Greenhouse Gas Emissions Summary by Sector, 1990, 2000, and 2001

Greenhouse Gas Categories	1990	2000	2001
		Mt CO_2 equivalent	
TOTAL	**608**	**730**	**720**
Electricity & Petroleum Industries	**193**	**272**	**273**
Electricity Generation[1]	95	136	137
Upstream Oil and Gas[2]	63	97	97
Upstream-Natural Gas Transmission	11	17	16
Petroleum Refining[3]	21	19	20
Downstream-Natural Gas Distribution	3	3	3
Transportation	**146**	**179**	**177**
Domestic Aviation	11	14	12
Gasoline Automobile	54	48	49
Light Duty Gasoline Trucks	22	38	39
Heavy Duty Gasoline Vehicles	3	4	4
Motorcycles	0.2	0.2	0.2
Diesel Automobiles	0.7	0.6	0.6
Light Duty Diesel Trucks	0.6	0.6	0.6
Heavy Duty Diesel Vehicles	25	39	39
Propane & Natural Gas Vehicles	2	1	1
Railways	7	7	7
Domestic Marine	5	5	6
Off Road	17	22	19
Industry	**117**	**114**	**108**
Mining[4]	7	10	10
Smelting and Refining Industries	16	17	17
Pulp and Paper and Sawmills	14	11	10
Primary & Other Steel Industries	14	16	14
Cement	9	10	10
Industrial Chemical Industries	28	20	18
Other Manufacturing	25	27	26
Other Industries	4	4	3
Solvent & Other Product Use	0.4	0.5	0.5
Residential, Commercial & Institutional	**70**	**78**	**75**
Commercial & Institutional	26	33	33
Residential	44	45	42
Agriculture	**59**	**61**	**60**
Enteric Fermentation	16	18	19
Manure Management	8	9	10
Agriculture Soils-Direct Sources	30	30	20
Agriculture Soils-Indirect Sources	5	7	7
Land Use Change and Forestry (non-CO_2 only)[5]	**2**	**0.7**	**2**
Prescibed Burns	2	0.6	0.6
Wildfires in the Wood Production Forest	0.7	0.1	2
Waste	**20**	**24**	**25**
Solid Waste Disposal on Land	19	23	23
Wastewater Handling	1	1	1
Waste Incineration	0.3	0.4	0.4
Land Use Change and Forestry[5]	**-100**	**-50**	**-40**

[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 in 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 are reported in the national totals.

Figures are rounded to reflect the uncertainty in the estimates.

- The Mining sub-sector accounted for 9.6 Mt of Canada's GHG emissions in 2001. 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 16% (17.4 Mt) to the Industry sector's GHG emissions in 2001. The bulk of these emissions are due to the release of gases with high global warming potential originating from aluminium and magnesium production processes. Process emissions from this sub-sector total 13.9 Mt of CO_2 eq with combustion emissions accounting for the balance.
- In 2001, the Ferrous Metal Production (Iron and Steel) sub-sector contributed 13.8 Mt (1.9%) to Canada's total greenhouse gas emissions. Stationary fuel combustion and process related sources accounted for 43% (5.9 Mt) and 57% (7.9 Mt) of the greenhouse gas emissions respectively.
- As shown in Figure 4, the Cement sub-sector accounted for 9% (9.8 Mt) of the total GHG emissions from the Industrial sector in 2001, with approximately two-thirds of the emissions produced as a result of the clinker production process.
- In 2001, GHG emissions from Industrial Chemical production are estimated at 17.6 Mt CO_2 eq, or 2.4% 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 an unintended by-product during the production of adipic acid and nitric acid.
- Overall, the Industry sector has experienced an 8% (10 Mt) decline in GHG emissions between 1990 and 2001, 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 switching.

Figure 3 Canada's Greenhouse Gas Emissions from Transportation Sources in 2001

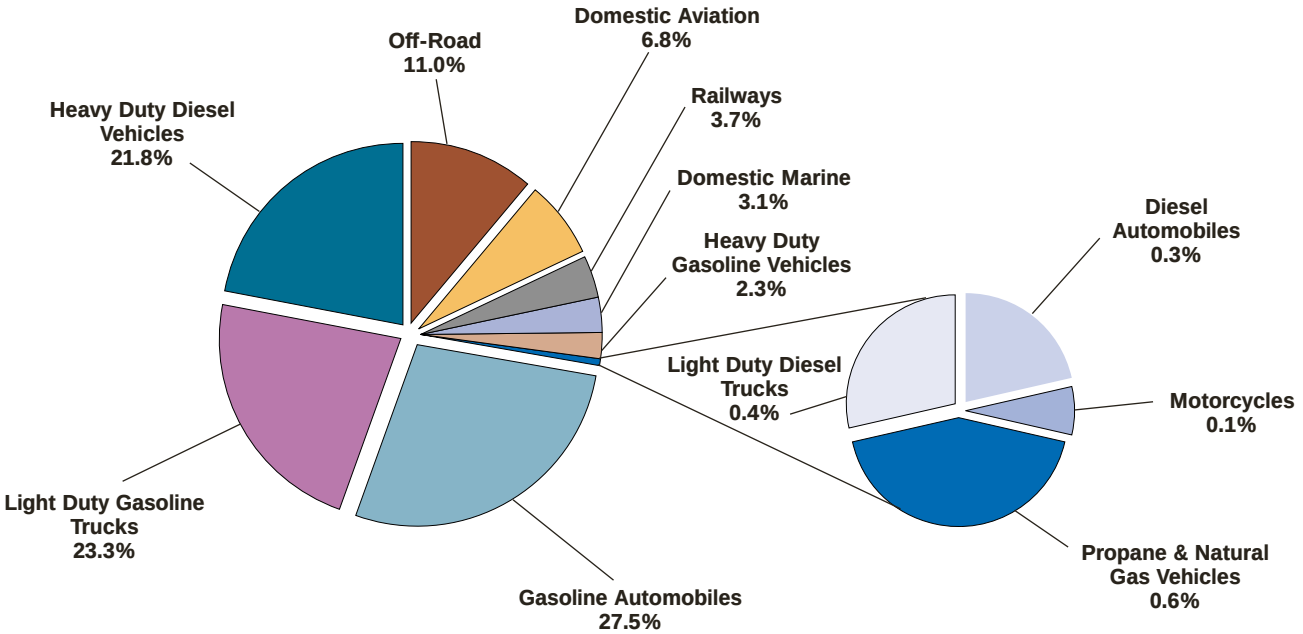
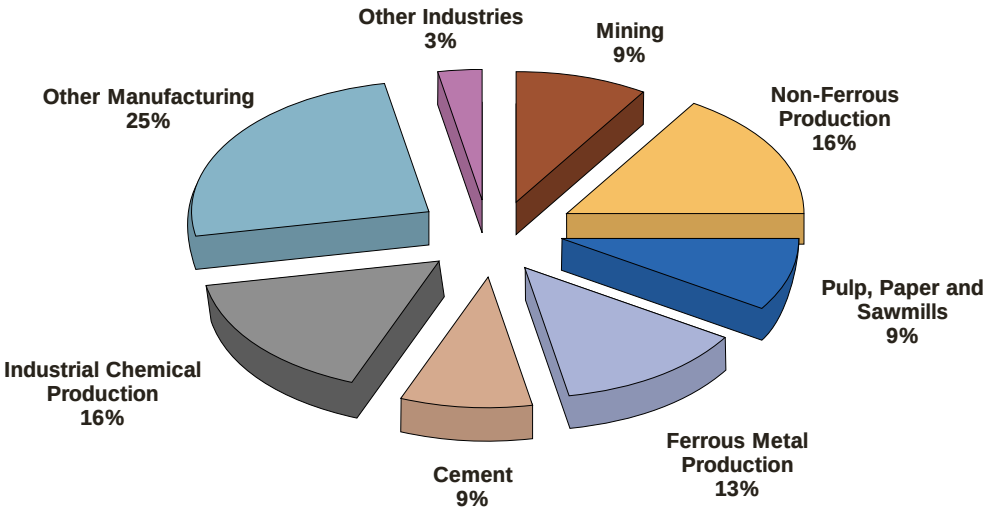


Figure 4 Breakdown of Canada's 2001 GHG Emissions in the Mining and Manufacturing Industries by Industrial Sub-sector



Residential, Commercial and Institutional (RCI) Sector

- The Residential, Commercial and Institutional sector contributed 75 Mt or 10.4% of Canada's greenhouse gas emissions in 2001. The Residential sector alone contributed about 42 Mt (5.8%), while the Commercial and Institutional sector contributed 33 Mt (4.6%).
- Overall, emissions grew by 7.1% since 1990. There was a 4.7% decrease in Residential and a 27% increase in emissions for the Commercial and Institutional sectors.
- An 8.2% decrease in heating degree days for space heating contributed to a decline in the use of fossil fuels. This resulted in a 6.9% (or 3.1 Mt) drop in residential emissions between 2000 and 2001 (Statistics Canada, 2002).

Agriculture

- In 2001, Agriculture-related greenhouse gas emissions totalled 60 Mt, and contributed 8% of total national emissions. This sector accounted for 70% of Canada's total emissions of nitrous oxide and 26% of methane emissions.
- On a category basis, agricultural soils contributed 52% of the sector's emissions (31.1 Mt) in 2001, enteric fermentation emissions from domestic animals 31% (18.8 Mt), and manure management 17% (10.1 Mt).
- While total sector emissions rose 2% between 1990 and 2001, emissions from manure management rose 22% 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 0.3 Mt in 2001. Nitrous oxide emissions from soils, however, rose 15% over the period.

Land-Use Change and Forestry (LUCF)

- The LUCF sector was a net sink of emissions in 2001, as it removed an estimated 34 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 36 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 an additional reduction of 5% of total Canadian emissions in 2001. Non-carbon dioxide emissions, however, are included in the national totals and amounted to 2 Mt in 2001. 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).
- Between 1990 and 2001, the LUCF sector overall remained a net sink but exhibited a 66% decline in the net removal over the period (from 105 Mt to 34 Mt).
- Overall, the trends observed in the LUCF category largely reflect the changing levels of industrial forestry activity during the 1990s. Including carbon storage in harvested wood products in the calculations 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.
- On-going 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 24.8 Mt or 3.4% to Canada's greenhouse gas emissions in 2001. Solid waste disposal on land accounted for more than 93% (23 Mt) of the Waste sector's greenhouse gas emissions, while wastewater handling and waste incineration accounted for 5.5% (1.4Mt) and 1.4% (0.4 Mt), respectively.
- In 2001, methane captured by landfill gas collection systems contributed to a 22% (or 5.9 Mt CO_2 eq) reduction in direct atmospheric emissions of methane from municipal solid waste. This resulted in a net release of 21 Mt.
- Methane captured by landfill gas collection systems has increased by 33% (5.5 Mt), since 1990.

Provincial and Territorial Greenhouse Gas Emissions

Table 3 provides a summary of greenhouse gas emissions by province and territory for 1990 and 2001 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.

Greenhouse gas emissions across Canada are not distributed evenly. 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 3 illustrates the provincial and territorial contributions to Canada's total emissions in 2001. The largest provincial contributors were Alberta with 31% of Canada's total emissions (224 Mt), and Ontario, which accounted for 28% of the national total (201 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 2001 were from Manitoba, Nova Scotia and New Brunswick (each accounting for about 3%). Newfoundland and Labrador added 1%, while Prince Edward Island and the territories together contributed less than 1% to total national emissions in 2001.

In terms of emissions growth, all provinces and territories except the Yukon (-14%) experienced an increase in their emissions over the 1990 to 2001 period. Although accounting for only 0.3% of total national emissions in 2001, the Northwest Territories and Nunavut collectively incurred the largest emissions growth at 50%. Emissions from New Brunswick rose 43%, and Alberta, British Columbia and Saskatchewan showed increases ranging between 23% and 31%. In addition, during this eleven year period four provinces were responsible for almost 90% of the total national growth in emissions - Alberta accounted for 47% of the total growth, while Ontario and Saskatchewan contributed 18% and 12%, respectively, and British Columbia added 11%.

Over the short term, most regions exhibited transportation related changes which saw diesel-based emissions decrease. This resulted mainly from decreased shipping associated with reduced manufacturing output. Gasoline-related emissions increased due mainly to the use of light duty gasoline trucks for personal transportation. However, an increase in emissions was also seen from light duty gasoline automobiles (cars), while those from domestic aviation decreased. These 2 sectors exhibited opposite trends over the longer term (1990-2001). This anomaly is most likely a result of the reduced desire for air travel and the increased desire for the perceived security of personal

Table 3 Summary of Provincial and Territorial Greenhouse Gas Emissions by Sector, 1990 and 2001

	NF	PE	NS	NB	QC	ON	MB	SK	AB	BC	NT & NU	YT
1990 GHG Emissions by Sector						**kt CO_2 equivalent**						
Energy	8,890	1,470	17,800	14,700	59,400	136,000	12,600	34,500	143,000	42,200	1,550	507
Industrial Processes	77	3	300	154	12,600	26,700	455	587	8,800	2,840	3	1
Solvent and Other Product Use	9	2	14	11	106	155	17	15	38	50	1	0
Agriculture	77	408	609	495	8,060	11,600	6,760	11,200	17,400	2,580	-	-
Land-Use Change and Forestry	18	0	2	19	44	129	24	258	114	1,590	-	61
Waste	364	77	593	499	5,770	7,170	424	504	1,010	3,640	14	7
Total	**9,440**	**1,960**	**19,400**	**15,900**	**86,000**	**181,000**	**20,300**	**47,000**	**171,000**	**52,900**	**1,570**	**575**
2001 GHG Emissions by Sector												
Energy	9,030	1,570	19,300	21,300	61,200	163,000	12,100	47,500	192,000	53,900	2,320	477
Industrial Processes	23	3	263	266	13,400	17,500	459	2,070	11,100	2,650	5	1
Solvent and Other Product Use	8	2	14	11	112	179	17	15	46	62	1	0
Agriculture	43	397	591	536	8,160	10,900	6,800	10,000	19,700	2,790	-	-
Land-Use Change and Forestry	14	-	2	6	271	122	425	468	225	492	0	6
Waste	437	93	718	614	6,810	8,490	618	623	1,230	5,120	19	9
Total	**9,550**	**2,060**	**20,900**	**22,700**	**90,000**	**201,000**	**20,400**	**60,700**	**224,000**	**65,000**	**2,350**	**492**
Absolute Change in Emissions (kt) 1990-2001	110	100	1,500	6,800	4,000	20,000	100	13,700	53,000	12,100	780	-83
Relative Change in Emissions (%) 1990-2001	1%	5%	8%	43%	5%	11%	0%	29%	31%	23%	50%	-14%
Relative Contribution to Absolute Growth in emissions (%)	NA	0.1%	1.3%	6.1%	3.6%	17.9%	0.1%	12.2%	47.3%	10.8%	0.7%	-0.1%
2001 GHG per capita[1] (tonnes GHG/person) (National average - 23.1 tonnes/person)	17.9	14.8	22.2	30.0	12.1	16.9	17.8	59.7	73.2.	15.8	33.9	16.3
2001 GHG Intensity of GDP[2] (GHG kt CO_2 eq/million $ GDP)	0.76	0.65	0.90	1.20	0.41	0.47	0.62	1.97	1.82	0.52	0.60	0.44
(National Average - 0.72)												

- 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.
- Sources: Emissions data from Environment Canada, *Canada's Greenhouse Gas Inventory 1990-2001* (in press);

[1]Population data from Statistics Canada, 2001, Catalogue #91-213;
[2]GDP data from Statistics Canada, CANSIM II, Table 384-0002.

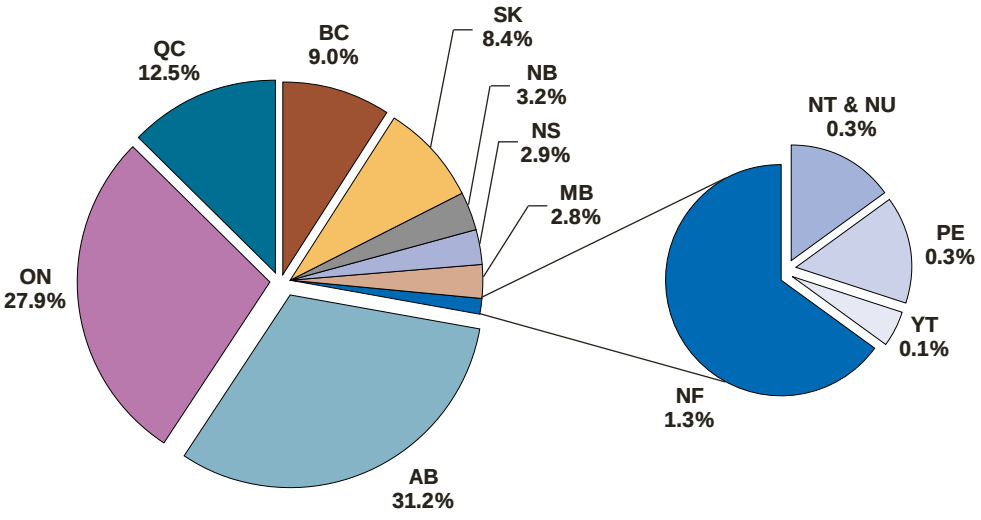
ground transportation following the events of September 11, 2001.

Excluding CO_2 emissions from agricultural soils, total emissions from the Agriculture sector increased by 17% between 1990 and 2001 (from 51.6 Mt to 60.3 Mt) nationally. On a provincial basis, CH_4 and N_2O emissions have increased steadily from 5.6 to 7.1 Mt in Manitoba, from 8.9 to 12.7 Mt in Saskatchewan, and from 14.2 to 18.0 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 are mainly the result of livestock expansion and higher synthetic nitrogen fertilizer consumption. Collectively they have contributed to most of the increases in Canada's non-CO_2 greenhouse gas 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 practices.

For a complete summary of provincial and territorial emissions for the years 1990 through 2001 inclusive, consult Environment Canada's *Greenhouse Gas Emissions* web site at

www.ec.gc.ca/pdb/ghg

Figure 5 Relative Provincial and Territorial Contributions to Canada's Greenhouse Gas Emissions in 2001



References

CIEEDAC (2003), A Review of Energy Consumption in Canadian Oil Refineries 1990, 1994 to 2001, Simon Fraser University

Informetrica Limited and Statistics Canada (2003), Industrial GDP at Basic Prices by NAICS code in 1997 Dollars

Statistics Canada, Quarterly Report on Energy Supply-Demand in Canada, Catalogue #57-003.

NRCan (1990-2001), Canadian Minerals Yearbook, annual editions, Natural Resources Mining Sector, Natural Resources Canada

Statistics Canada (2001), Industrial Chemicals and Synthetic Resins, Catalogue No. 46-006, Statistics Canada

BEA (Bureau of Economic Analysis) 2002, National Income and Product Accounts Tables, Table 1.2 Real Gross Domestic Product billions of chained (1996) dollars; accessed April 11th 2003; web site: www.bea.doc.gov/bea/dn/nipaweb

Environment Canada, Canada's Greenhouse Gas Inventory 1990 - 2001 (in press).

Intergovernmental Panel on Climate Change (IPCC), *Greenhouse Gas Inventory Reporting Instructions*, Vol. 1; and Greenhouse Gas Inventory Reference Manual, Vol. 3, Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, 1997.

Statistics Canada, *Population, CANSIM II Table 051-0001.*

Statistics Canada, *Real Gross Domestic Product, (Million 1997 Chained dollars) CANSIM 380-0002 Series V1992067.*

Statistics Canada, *Quarterly Report on Energy Supply-Demand in Canada* (QRESD), Catalogue #57-003.

T.J. McCann and Associates, et al., *Fossil Fuel Energy Trade & Greenhouse Gas Emissions,* Prepared for Environment Canada, 1997.

United Nations Framework Convention on Climate Change, *Review of the Implementation of Commitments and of Other Provisions of the Convention*, FCCC/CP/1999/7.

U.S. Environmental Protection Agency, *DRAFT INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2001, US EPA, Figure ES-1, URL: http://www.epa.gov/globalwarming/publications/emissions*

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