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National Inventory Report

1990–2012

GREENHOUSE GAS SOURCES AND SINKS IN CANADA

The Canadian Government's Submission to the UN Framework Convention on Climate Change

Executive Summary

Canada

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Executive Summary

ES.1 Introduction

The United Nations Framework Convention on Climate Change (UNFCCC) is an international treaty established in 1992 to cooperatively tackle climate change issues. The ultimate objective of the UNFCCC is to stabilize atmospheric greenhouse gas (GHG) concentrations at a level that would prevent dangerous interference with the climate system. Canada ratified the UNFCCC in December 1992, and the Convention came into force in March 1994. At the 15th session of the Conference of the Parties (COP15) to the UNFCCC in 2009, Canada signed the Copenhagen Accord, under which Canada has committed to reducing its GHG emissions to 17% below the 2005 level by the year 2020.[1]

To achieve its objective and implement its provisions, the UNFCCC lays out several guiding principles and commitments. Specifically, Articles 4 and 12 commit all Parties to develop, periodically update, publish and make available to the COP the national inventories of anthropogenic emissions by sources and removals by sinks of all GHGs not controlled by the Montreal Protocol.[2]

Canada's National Inventory is prepared and submitted annually to the UNFCCC by April 15 of each year, in accordance with the December 2005 version of the *Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines for national inventories*. The annual inventory submission consists of the National Inventory Report (NIR) and the Common Reporting Format (CRF) Tables.

The inventory estimates include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), perfluorocarbons (PFCs) and hydrofluorocarbons (HFCs), in the following six Intergovernmental Panel on Climate Change (IPCC) sectors: Energy, Industrial Processes, Solvent and Other Product Use, Agriculture, Waste, and Land Use, Land-Use Change and Forestry (LULUCF). The GHG emission and removal estimates contained within Canada's GHG inventory are developed using methodologies consistent with the inventory guidelines prepared by the IPCC. Given that the underlying data and methodology for estimating emissions are revised over time, emissions levels in all years are subject to change as both data and methods are improved.

Section ES.2 summarizes the latest information on Canada's net anthropogenic GHG emissions over the period 1990–2012, and links this information to relevant indicators of the Canadian economy. Section ES.3 outlines the major trends in emissions from each of the IPCC sectors.

There are several methods to categorize the sources of GHG emissions. For the purposes of analyzing trends and policies, it is useful to allocate emissions to the economic sector from which they originate. As such, this report also presents emissions by the following economic sectors: Oil and Gas, Electricity, Transportation, Emissions Intensive and Trade Exposed Industries, Buildings, Agriculture, Waste and Others. This is the approach taken for reporting against Canada's Copenhagen target[3] in the annual *Canada's Emissions Trends* report (Environment Canada 2013) as well as *Canada's Sixth National Communication and First Biennial Report* (Environment Canada 2014). Throughout this report, the word "Sector" generally refers to activity sectors as defined by the IPCC for national GHG inventories; exceptions occur when the expression "economic sectors" is used in reference to the Canadian context. Section ES.4 presents a synopsis of GHG emissions by economic sector, consistent with that submitted to the UNFCCC.

Canada is a geographically large federation composed of a federal government, 10 provincial governments, and three territories. Natural resources, including energy, fall mainly under provincial jurisdiction. Section ES.5 details GHG emissions for Canada's 13 sub-national jurisdictions.

Canada's annual inventory submission to the UNFCCC embodies over a decade of learning and improvements. Section ES.6 provides some detail on the components of this submission, and outlines key elements of its preparation.

ES.2 Overview, National GHG Emissions

In 2012, the most recent annual dataset in this report, Canada's total GHG emissions were estimated to be 699 megatonnes of carbon dioxide equivalent (Mt CO_2 eq[4]), excluding LULUCF estimates. The Energy Sector (consisting of the Stationary Combustion Sources, Transport, and Fugitive Sources subsectors) accounted for the majority of Canada's GHG total emissions in 2012, at 81% or 566 Mt (Figure S–1). The remaining 19% of total emissions was largely generated by sources within the Agricul-

1 See http://www.climatechange.gc.ca/default.asp?lang=En&n=AA3F6868-1.

2 Under the United Nations Environment Programme (UNEP), the Montreal Protocol on Substances that Deplete the Ozone Layer is an international agreement designed to reduce the global consumption and production of ozone-depleting substances.

3 See http://www.climatechange.gc.ca/default.asp?lang=En&n=AA3F6868-1.

4 Unless explicitly stated otherwise, all emission estimates given in Mt represent emissions of GHGs in Mt CO_2 equivalent.

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Figure S–1 Canada's Emissions Breakdown by IPCC Sector (2012)

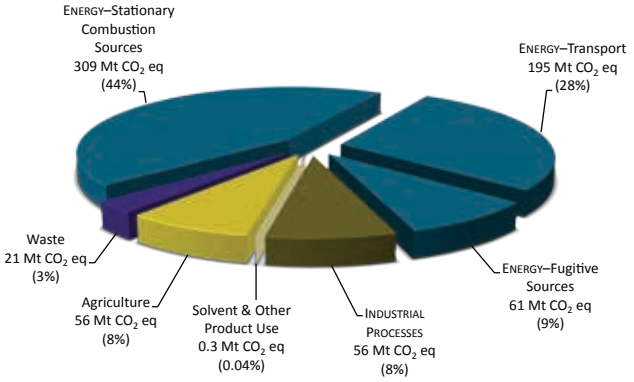
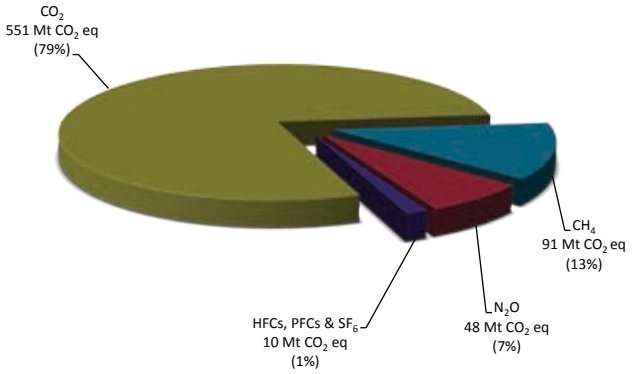
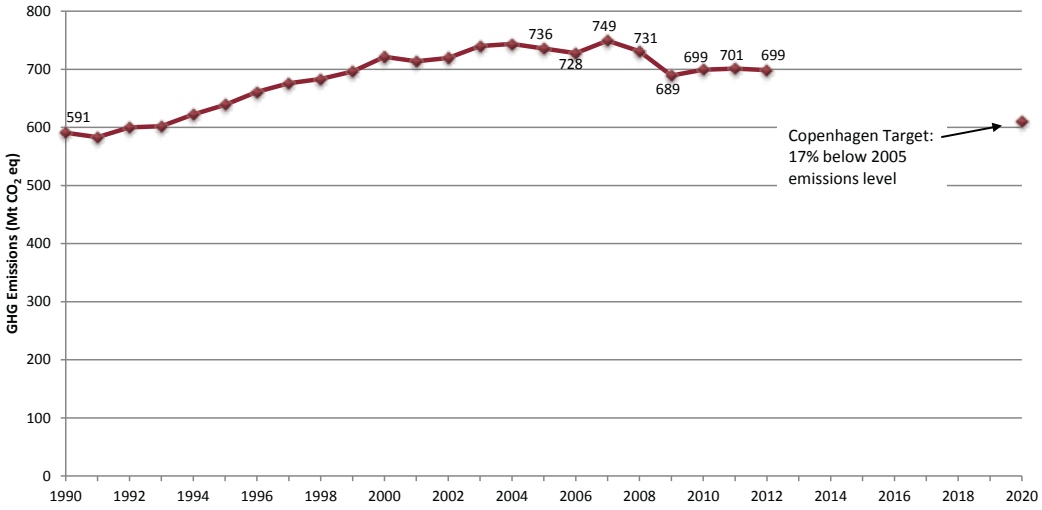


Figure S–2 Canada's Emissions Breakdown by Greenhouse Gas (2012)



Total: 699 Mt CO_2 eq

Figure S–3 Canadian GHG Emissions Trend (1990–2012) and Copenhagen Target



ture Sector (8% of total emissions) and Industrial Processes Sector (8%), with minor contributions from the Waste Sector (3%). The LULUCF Sector was a net source of 41 Mt in 2012; in accordance with UNFCCC reporting guidelines, these emissions are excluded from national inventory totals.

In 2012, CO_2 contributed 79% of Canada's total emissions (Figure S–2). The majority of these emissions result from the combustion of fossil fuels. CH_4 accounted for 13% of Canada's total emissions, largely from fugitive emissions from oil and natural gas systems, as well as domestic livestock and landfills. N_2O emissions, from activities such as agriculture soil management and transportation, accounted for 7% of emissions. Emissions of the synthetic gases (PFCs, SF_6 and HFCs) constituted the remainder (slightly more than 1%).

Canada's emissions in 2012 were 108 Mt (18%) above the 1990 total of 591 Mt (Figure S–3). Steady increases in annual emissions characterized the first 15 years of this period, followed by fluctuating emission levels between 2005 and 2008, a steep drop in 2009, and more stable values thereafter. Between 2005 and 2012, emissions decreased by 37 Mt (5%), primarily due to decreases in the Electricity and Heat Generation subsector and Manufacturing Industries subsector (Table S–2).

Though GHG emissions have risen by 18% since 1990, Canada's economy grew much more rapidly, with the Gross Domestic Product (GDP) rising by 67%. As a result, the emission intensity for the entire economy (GHG per GDP) has improved considerably, dropping by 29% (Figure S–4 and Table S–1). Early in the period, emissions rose nearly in step with economic growth, with their paths beginning to diverge in 1995 (Figure S–4). In 1995, GHG emissions started to decouple from economic growth, a shift that can be attributed to increases in efficiency, the modernization of industrial processes, and structural changes in the economy. These long-term trends have led to continued

Figure S–4 Indexed Trend in GHG Emissions and GHG Emissions Intensity (1990–2012)

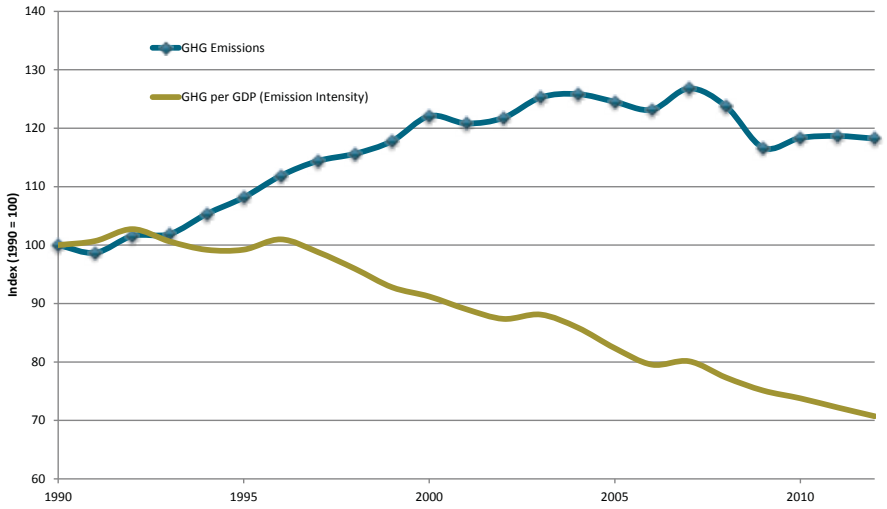
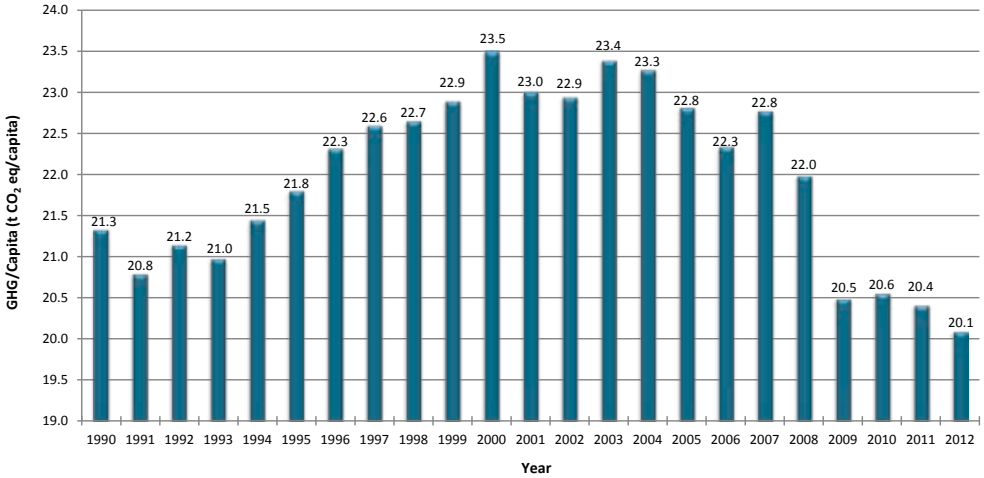


Table S–1 Trends in Emissions and Economic Indicators, Selected Years

Year	1990	2000	2005	2008	2009	2010	2011	2012
Total GHG (Mt)	591	721	736	731	689	699	701	699
Change Since 2005 (%)	NA	NA	NA	-0.6%	-6.3%	-5.0%	-4.7%	-5.1%
Change Since 1990 (%)	NA	22.1%	24.5%	23.7%	16.7%	18.3%	18.7%	18.2%
GDP (Billions 2007$)	989	1 324	1 496	1 583	1 537	1 587	1 626	1 654
Change Since 2005 (%)	NA	NA	NA	5.8%	2.7%	6.1%	8.7%	10.6%
Change Since 1990 (%)	NA	33.8%	51.2%	60.0%	55.3%	60.4%	64.3%	67.2%
GHG Intensity (Mt/$B GDP)	0.60	0.54	0.49	0.46	0.45	0.44	0.43	0.42
Change Since 2005 (%)	NA	NA	NA	-6.1%	-8.8%	-10.4%	-12.3%	-14.1%
Change Since 1990 (%)	NA	-8.8%	-17.6%	-22.7%	-24.9%	-26.2%	-27.8%	-29.3%

GDP Data Source: Statistics Canada. Table 380-0106 - Gross domestic product at 2007 prices, expenditure-based, annual (dollars), CANSIM (database).

Figure S–5 Canadian per Capita Greenhouse Gas Emissions (1990–2012)



Population data source: Statistics Canada (2013a)

improvement in emissions intensity since the late 1990s. Chapter 2 provides more information on trends in GHG emissions.

Canada represented less than 2% of total global GHG emissions in 2010 (CAIT 2013), although it is one of the highest per capita emitters, largely as a result of its size, climate (i.e. climate-driven energy demands) and resource-based economy. In 1990, Canadians released 21.3 tonnes (t) of GHGs per capita. In 2005 this had risen to 22.8 t; however, by 2012, it had dropped to an historic low of 20.1 t of GHGs per capita (Figure S–5).

ES.3 Emissions and Trends by IPCC Sectors

Overall Trends in Emissions

Over the period 1990–2012, total emissions grew by 108 Mt or 18%. This was driven mainly by a 97 Mt CO_2 eq (21%) increase in the Energy Sector. Increases were seen across all other sectors as well: 9 Mt CO_2 eq (19%) in the Agriculture Sector, 2 Mt CO_2 eq (8%) in the Waste Sector, 1 Mt CO_2 eq (1%) in the Industrial Processes Sector, and 0.1 Mt CO_2 eq (74%) in the Solvent and Other Product Use Sector (Figure S–6).

Table S–2 provides additional details about Canada's emissions and removals by IPCC sector for the years 1990, 2000, 2005 and 2008–2012. Further breakdowns by subsector and gas, and a complete time series, can be found in Annex 12.

In contrast to the increase of emissions over the longer term (1990–2012), total Canadian GHG emissions have decreased by 37 Mt (5%) since 2005. The Stationary Combustion Sources subsector within the Energy Sector has been the largest driver of the overall downward trend, dropping by 29 Mt since 2005 (Figure S–7), with the largest contributor to this reduction being the Electricity and Heat Generation category within this subsector, where emissions fell 35 Mt (28%). Emissions from the Industrial Processes Sector, Agriculture Sector, Fugitive Sources subsector within the Energy Sector, and Waste Sector have also dropped (by 4 Mt, 3 Mt, 2 Mt and 1 Mt, respectively), while emissions from the Transport subsector (also within the Energy Sector) increased by 2 Mt.

The following describes the emissions and trends of each IPCC sector in further detail.

Energy—2012 GHG Emissions (566 Mt)

Short-term Trends

In 2012, GHG emissions from the IPCC Energy Sector were 29 Mt (about 5%) below 2005 levels. Similar to the national trend, this decline was primarily driven by a decline in fossil fuel consumption for the Electricity and Heat Generation category and Manufacturing Industries category within the sector.

Decreasing generation by coal and oil sources, accompanied by an increase in hydro, nuclear and wind generation, was the largest driver of a 35 Mt (about 28%) decrease in emissions associated with Electricity and Heat Generation between 2005 and 2012. However, there were some fluctuations in emissions over that period, largely as a result of changes in the mix of electricity generation sources.[5] Chapter 2 provides more information on trends in GHG emissions.

5 The mix of electricity generation sources is characterized by the amount of fossil fuel vs. hydro, other renewable sources and nuclear sources. In general, only fossil fuel sources generate net GHG emissions.

Figure S–6 Trends in Canadian GHG Emissions by IPCC Sector (1990–2012)

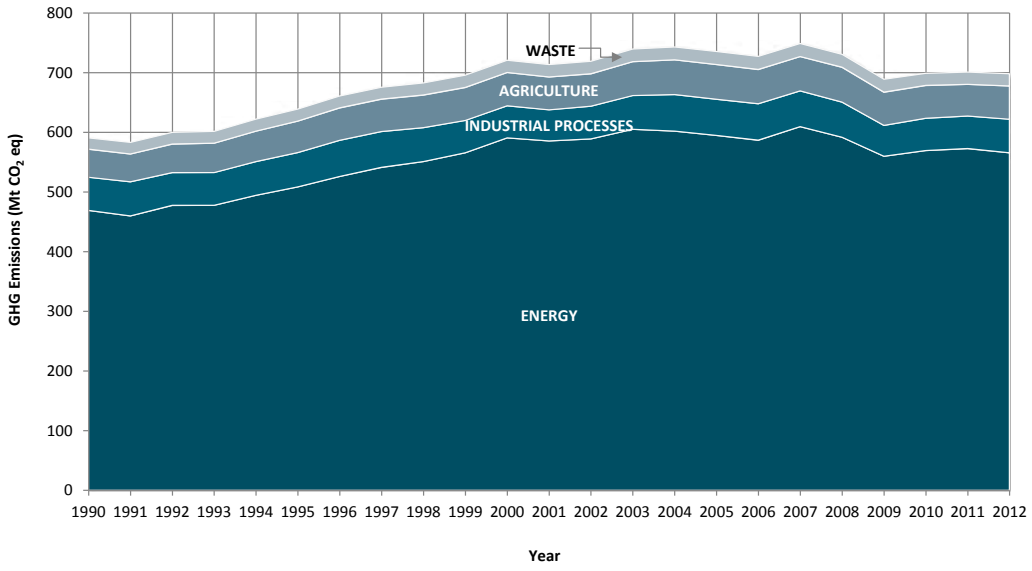


Table S–2 Canada's GHG Emissions by IPCC Sector (1990–2012)

Greenhouse Gas Categories		1990	2000	2005	2008	2009	2010	2011	2012
		Mt CO_2 equivalent							
TOTAL[1,2]		591	721	736	731	689	699	701	699
ENERGY		469	591	595	592	560	570	573	566
a.	Stationary Combustion Sources	280	347	338	334	313	313	316	309
	Electricity and Heat Generation	94	130	123	115	99	101	94	88
	Fossil Fuel Production and Refining	51	68	68	65	65	63	62	63
	Mining & Oil and Gas Extraction	7	12	19	30	32	35	36	41
	Manufacturing Industries	56	56	48	45	40	41	45	43
	Construction	2	1	1	1	1	1	1	1
	Commercial & Institutional	26	33	32	30	29	28	30	28
	Residential	43	45	44	46	44	41	44	41
	Agriculture & Forestry	2	3	2	3	3	3	3	4
b.	Transport	147	180	194	196	188	198	198	195
	Civil Aviation (Domestic Aviation)	7	8	8	7	6	6	6	6
	Road Transportation	97	118	130	132	132	134	132	132
	Railways	7	7	7	8	5	7	8	8
	Navigation (Domestic Marine)	5	5	7	7	7	7	6	6
	Other Transportation	31	43	42	42	38	44	46	43
c.	Fugitive Sources	42	63	63	62	59	58	60	61
	Coal Mining	2	1	1	1	1	1	1	1
	Oil and Natural Gas	40	62	62	61	58	57	59	60
INDUSTRIAL PROCESSES		56	54	60	59	52	54	55	56
a.	Mineral Products	8	10	10	9	7	8	8	8
b.	Chemical Industry	16	8	9	9	7	6	7	7
c.	Metal Production	23	23	20	19	15	16	17	16
d.	Production and Consumption of Halocarbons and SF_6	1	3	5	6	7	7	8	8
e.	Other & Undifferentiated Production	7	10	16	16	16	17	15	17
SOLVENT & OTHER PRODUCT USE		0.2	0.4	0.4	0.3	0.3	0.2	0.2	0.3
AGRICULTURE		47	56	58	58	56	55	53	56
a.	Enteric Fermentation	16	20	22	20	19	18	17	18
b.	Manure Management	6	7	8	7	7	7	6	6
c.	Agriculture Soils[3]	25	29	29	31	30	30	29	32
WASTE		19	21	22	22	22	20	20	21
a.	Solid Waste Disposal on Land	17	19	20	20	20	19	19	19
b.	Wastewater Handling	1	1	1	1	1	1	1	1
c.	Waste Incineration	1	1	1	1	1	1	1	1
Land Use, Land-use Change and Forestry		-71	-52	53	-17	-27	76	77	41
a.	Forest Land	-98	-65	44	-26	-35	68	69	32
b.	Cropland	12	0	-4	-5	-5	-5	-5	-5
c.	Grassland	1	1	1	0	0	0	1	1
d.	Wetlands	5	3	3	3	3	3	3	3
e.	Settlements	9	9	10	10	9	10	10	10

Notes:
1. National totals exclude all GHGs from the Land Use, Land-use Change and Forestry Sector.
2. These summary data are presented in more detail in Annex 12.
3. Includes emissions from Field Burning of Agricultural Residues.

Sectors shaded in grey represent those sectors with significant contributions to trends as described in Section ES.3

GHG emissions from the Manufacturing Industries category dropped by 5.4 Mt (11%) between 2005 and 2012 while industries continue to recover from a decrease in production in 2009.

Long-term Trends

The largest portion of Canada's total emissions growth is observed in the Energy Sector. The long-term sector emission trends (1990–2012) show a net growth of 97 Mt or 21%. As described in Section ES.2, most of the growth in national emissions is observed in the Mining & Oil and Gas Extraction category and the Road Transportation category, which fall under the Energy Sector. The largest decreases in Energy Sector emissions were observed in the Manufacturing Industries category followed by the Electricity and Heat Generation category.

In 2012, emissions from the Mining & Oil and Gas Extraction category were about five times their 1990 values. Related to this

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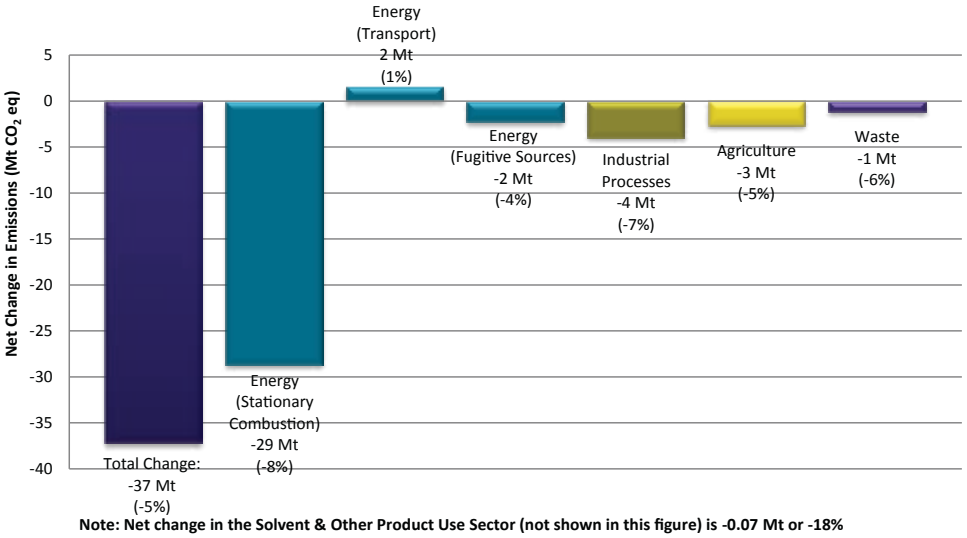
Figure S–7 Short-term Emission Trends by IPCC Sector (2005–2012)



Note: Net change in the Solvent & Other Product Use Sector (not shown in this figure) is -0.07 Mt or -18%

has been a 72% increase in total production of crude oil and natural gas over the period. In addition, per-barrel GHG emissions from oil and gas production have been rising, due to an increase in the complexity of techniques used to produce conventional oil and to ongoing growth of oil production from the oil sands. However, the emissions intensity of oil sands operations declined steadily until about 2004, due to technological innovation and equipment turnover, increased reliability across operations, and the avoidance of upgrading emissions by exporting more crude bitumen. The most significant factor contributing to this overall trend has been declining rates of emissions associated with fuel combustion. Since 2004, the emissions intensity from oil sands operations has remained fairly static.

The majority of transportation emissions in Canada are related to the Road Transportation category, which dominated the GHG growth trend in this area. Emissions from Road Transportation rose by 35.8 Mt (37%) between 1990 and 2012. However, as vehicles are becoming more efficient, the rate of growth in emissions from Road Transportation has slowed, and emissions from this category have remained stable since 2008.

The primary source of this net trend of rising emissions is the increase in the number of passenger-kilometres travelled (more people drove further) (NRCan 2013). In addition, the use of light trucks, a vehicle class that includes sport-utility vehicles and minivans, increased much more rapidly than cars. Given that light trucks have higher fuel consumption than cars, this shift also drove emission increases (NRCan 2013).

Emissions from heavy-duty diesel vehicles (large freight trucks) rose by 21.7 Mt (109%) between 1990 and 2012. Growth in emissions reflected a 137% increase in tonne-kilometres shipped by for-hire trucking between 1990 and 2003 (Statistics Canada 2013b). Between 2004 and 2011, tonne-kilometres shipped oscillated between +4% (2004–2005) and -7% (2008–2009), and ultimately resulted in zero growth across the seven-year period (Statistics Canada 2013c).

Industrial Processes—2012 GHG Emissions (56.5 Mt)

The Industrial Processes Sector covers GHG emissions arising from non-energy sources such as limestone calcination (CO_2) in cement production, or the use of HFCs and PFCs as replacement refrigerants for ozone-depleting substances (ODSs). Since 1990 the emissions in this sector have fluctuated, with peaks in 1996 and 2004; in 2012 emissions were 1.3% (0.75 Mt) above their 1990 level, and 3.3% (1.8 Mt) above the 2011 level. Of note in this sector is the rapid increase in emissions from the use of HFCs as refrigerants in place of ODSs, an increase of 2.5 Mt (47%) since 2005.

In the Metal Production category, CO_2 emissions from production of iron and steel have been fairly stable since the early 1990s, despite moderate increases in steel production, indicating the effect of increased use of recycled steel in Canadian steelmaking operations. The year 2009 saw a significant decline in production, followed by a gradual recovery from 2010 to 2012. The aluminium industry, while increasing its production by almost 100% since 1990, shows a reduction of its process emissions by 33% (3.1 Mt), largely due to emission control technology introduced by the sector to mitigate PFC emissions. The 57% reduction achieved overall in GHG emissions from industrial chemical processes between 1990 and 2012 is primarily a result of closure of an adipic acid plant in Ontario. Decreases were partly offset by increases in emissions within the Ammonia Production and Nitric Acid Production categories.

Agriculture—2012 GHG Emissions (56 Mt)

Canadian agriculture can be differentiated into livestock and crop production components. The livestock industry is dominated by beef but also has large swine, dairy and poultry components. Crop production is mainly dedicated to the production of cereal and oil seeds. A wide variety of specialty crops and animals are produced, but represent a very small portion of the overall agricultural economy.

Emissions directly related to animal and crop production accounted for 56 Mt CO_2 eq or 8.0% of total 2012 GHG emissions for Canada, an increase of 9 Mt CO_2 eq or 19% since 1990. Agriculture accounts for 22% and 74% of the national CH_4 and N_2O emissions, respectively.

The main drivers of the increase in emissions since 1990 in the Agriculture Sector are the expansion and intensification of the beef cattle and swine industries, and increases in the application of synthetic nitrogen fertilizers in the Prairies.

From 2005 to 2008, livestock populations decreased, while synthetic fertilizer consumption continued to increase and crop production was high; declines in emissions from livestock production were compensated for by increases in emissions from crop production. These trends have persisted in recent years, such that during the period 2005–2012 the relative proportion of emissions from livestock has steadily decreased from 67% to 57% of total agricultural emissions.

Waste—2012 GHG Emissions (21 Mt)

The primary source category in the Waste Sector is CH_4 emissions from Solid Waste Disposal on Land, which accounted for about 92% of emissions for this sector. The CH_4 emissions from publicly and privately owned municipal solid waste landfills make up the bulk of emissions in the Solid Waste Disposal on Land category (approximately 87%). The remainder (approximately 13%) originates from pulp and paper and sawmill industries that landfill wood residues on-site; this practice is declining as markets for wood residues grow.

Since 1990, the overall emissions from this sector grew by 8%, mostly from increases in emissions from landfill operations. The emissions from this sector were significantly mitigated by the growing amounts of landfill gas (LFG) captured and combusted at the landfill sites. While the CH_4 emissions generated by all landfills increased by 34% to 1208 kilotonnes (kt), the amount of CH_4 captured increased by 120% to 425 kt in 2012. Of the overall CH_4 captured, 48% was combusted for energy recovery applications and the remainder was flared. The number of landfill sites with LFG capture systems is rapidly rising in Canada, with 81 such systems operating in 2012.

Wastewater treatment and waste incineration facilities in Canada are minor sources of CH_4 and N_2O emissions, and have generally remained stable.

Land Use, Land-use Change and Forestry—2012 (Net Source of 41 Mt)

The Land Use, Land-use Change and Forestry (LULUCF) Sector reports GHG fluxes between the atmosphere and Canada's managed lands, as well as those associated with land-use change. In contrast with other inventory estimates, GHG emissions and removals from Canada's managed lands can include very large fluxes from non-anthropogenic events such as wildfires and insect epidemics. All emissions and removals in the LULUCF Sector are excluded from the national totals.

In this sector, the net GHG flux is calculated as the sum of CO_2 emissions to, and removals from, the atmosphere, plus non-CO_2 emissions. In 2012, this net flux amounted to emissions of 41 Mt CO_2 eq, which would have increased the total Canadian GHG emissions by about 6% but would include non-anthropogenic sources. Trends in the LULUCF Sector are primarily driven by those in the sector's Forest Land and Cropland subsectors and Forest Conversion categories.

The net flux in forest land displays an important inter-annual variability due to the erratic pattern of forest wildfires, which masks underlying patterns of interest in the sector. Important subsectoral trends associated with human activities in managed forests include a 28% increase in the carbon removed in harvested wood between 1990 and the peak harvest year of 2004. Since then, significant reductions in forest management activities have occurred, with a 35% decline in harvest levels, which in 2009 reached their lowest point for the 23-year period covered by this report (30 Mt carbon). Nonetheless, the immediate and longterm effect of major natural disturbances in managed forests, notably the Mountain Pine Beetle infestation in western Canada, will undoubtedly continue to dominate the apparent trend.

Cropland shows a steady decline in emissions, notably in the period 1990–2006, from emissions of 12 Mt CO_2 eq in 1990 to net removals of 5 Mt CO_2 eq in 2006. This trend is a result of changes in agricultural land management practices in western Canada, such as the extensive adoption of conservation tillage practices (over 13 million hectares [Mha] of cropland since 1990) and the reduction in summer fallow by 76% in 2012. The net CO_2 removals due to the management of mineral soils increased from 2 Mt in 1990 to 11 Mt in 2012. A decline in the conversion of forest land to cropland has also contributed to this trend. Since 2006, net removals have tended to remain constant at around 5 Mt CO_2 eq as a result of the soil sink approaching equilibrium.

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ES.4 Economic Sectors

As previously noted, there are several methods to categorize the sources of GHG emissions that arise across Canada. For the purposes of analyzing trends and policies, it is useful to allocate emissions to the economic sector from which the emissions originate. These emissions are presented in Figure S–8 and Table S–3. In general, a comprehensive emission profile for a specific economic sector is developed by reallocating the relevant proportion of emissions from various IPCC subcategories. This reallocation simply re-categorizes emissions under different headings and does not change the overall magnitude of Canadian emissions estimates.

Similar to the trends under IPCC sectors, the increase in GHG emissions between 1990 and 2012 was driven by growth in the oil and gas and transportation sectors. Increased production of crude oil as well as the expansion of the oil sands resulted in an increase in emissions of 72 Mt in the oil and gas sector. In the transportation sector, changes in subsectors such as light-duty and heavy-duty vehicles caused an increase in emissions of 37 Mt when compared to 1990 levels. These increases were offset by decreases in emissions in the Electricity and Emissions Intensive and Trade Exposed Industries, where emissions fell 6 Mt and 17 Mt, respectively.

Further information on the IPCC and economic sector definitions and trends, as well as a detailed cross-walk between IPCC and economic sector categories, can be found in Chapter 2, Table 2-14.

ES.5 Provincial and Territorial GHG Emissions

Emissions vary significantly by province, due to factors such as population and socio-economic considerations, economic structure and weather. For example, provinces where the economy

Figure S–8 Canada's Emissions Breakdown by Economic Sector (2012)

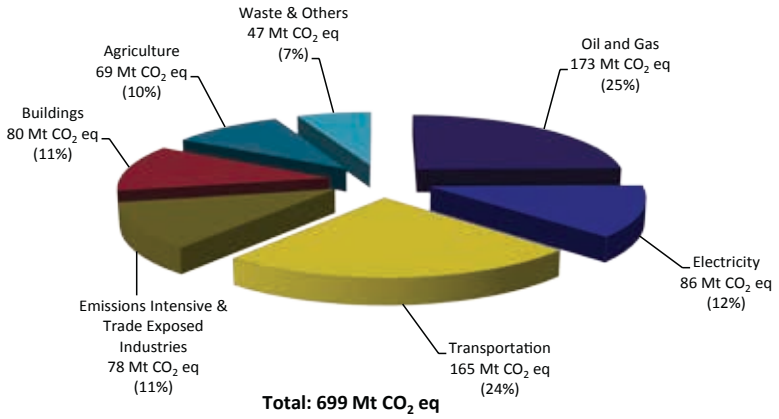


Table S–3 Canada's GHG Emissions by Economic Sector (1990-2012)

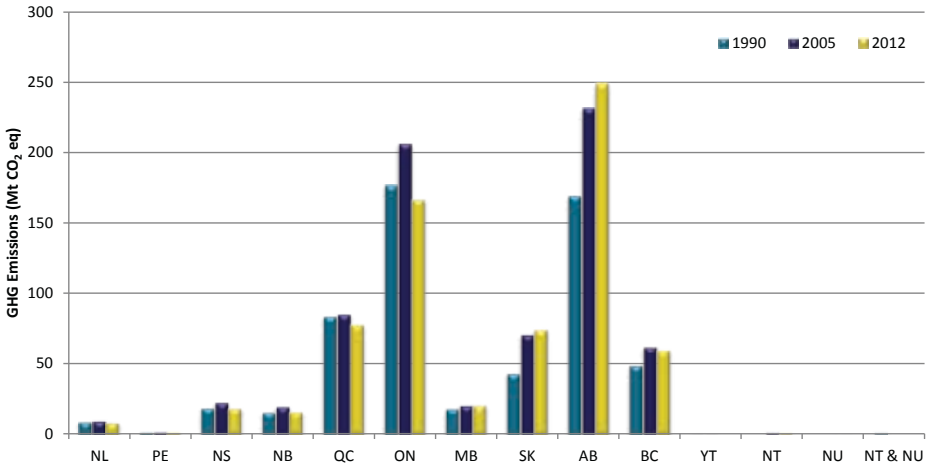
Greenhouse Gases	1990	2000	2005	2008	2009	2010	2011	2012
				Mt CO_2 equivalent				
NATIONAL GHG TOTAL	**591**	**721**	**736**	**731**	**689**	**699**	**701**	**699**
Oil and Gas	101	151	159	162	161	163	164	173
Electricity	94	129	121	113	97	99	92	86
Transportation	128	155	168	166	163	167	166	165
Emissions Intensive & Trade Exposed Industries[1]	95	92	89	88	75	76	80	78
Buildings	70	82	84	84	82	79	85	80
Agriculture	54	66	68	71	66	68	67	69
Waste & Others[2]	48	46	47	48	45	46	47	47

Note: Totals may not add up due to rounding.

Estimates presented here are under continual improvement. Historical emissions may be changed in future publications as new data become available and methods and models are refined and improved. Recalculations resulting from methodological improvements are presented in Chapter 9, and recalculations resulting from changes to underlying activity data are presented in the chapter(s) associated with the sector where the changes occurred (Chapters 3-8).

1. The Emissions Intensive & Trade Exposed Industries represent emissions arising from non oil and gas mining activities, smelting and refining, and the production and processing of industrial goods such as paper or cement.
2. "Others" includes Coal Production, Light Manufacturing, Construction & Forest Resources.

Figure S–9 Emissions by Province in 1990, 2005 and 2012



is oriented more toward resource extraction will tend to have higher emission levels, while service-based economies tend to have lower emission levels. Electricity generation sources also vary, with provinces that rely on fossil fuels for their electricity generation having higher emissions than provinces relying more on hydroelectricity.

Although Ontario, with its large manufacturing base, started off as the largest-emitting province in 1990, as of 2005 it had been surpassed by Alberta (see Figure S–9), where emissions have increased 47% since 1990—mostly driven by the enhanced production of petroleum resources.

Since 2005, Ontario's electricity sector saw its emissions decrease by 58% (19.7 Mt)—largely due to the closures of coal-fired electricity generation plants.

Quebec and British Columbia, which rely on abundant hydroelectric resources for their electricity production, show more stable emission patterns across the time series and a decreasing pattern since 2005. Quebec experienced an 8.5% (7.3 Mt) decrease from its 2005 emissions level, while British Columbia had a decline of 3.5% (2.2 Mt). In contrast to these decreases, emissions in Saskatchewan increased by 5.1% (3.7 Mt) between 2005 and 2012, as a result of activities in the oil and gas industry as well as potash and uranium mining.

ES.6 National System

Environment Canada is the single national entity with responsibility for the preparation and submission of the National Inventory Submission to the UNFCCC and for the establishment of a national inventory system. Canada`s national system for the estimation of anthropogenic emissions from sources and removals by sinks of all GHGs not controlled by the Montreal Protocol encompasses the institutional, legal and procedural arrangements necessary to ensure that Canada meets its reporting obligations.

The national system consists of institutional arrangements for the preparation of the inventory, including formal agreements supporting data collection and estimate development; a quality assurance / quality control plan; the ability to identify key categories and generate quantitative uncertainty analysis; a process for performing recalculations for improvement of the inventory; procedures for official approval; and a working archives system to facilitate third-party review.

Submission of information to the national system, including details on institutional arrangements for inventory preparation, is also an annual requirement under the UNFCCC reporting guidelines on annual inventories (see Chapter 1, Section 1.2).

Structure of Submission

The UNFCCC requirements include both the annual compilation and submission of the National Inventory Report (NIR) and Common Reporting Format (CRF) tables. The CRF tables are a series of standardized data tables, containing mainly numerical information, which are submitted electronically. The NIR contains the information to support the CRF tables, including a comprehensive description of the methodologies used in compiling the inventory, the data sources, the institutional structures and quality assurance and quality control procedures.

Part 1 of the NIR includes Chapters 1 to 9. Chapter 1 (Introduction) provides an overview of Canada's legal, institutional and procedural arrangements for producing the inventory (i.e. the national inventory system) as well as a description of Canada's facility emission-reporting system. Chapter 2 provides an analysis of Canada's GHG emission trends in accordance with the UNFCCC reporting structure as well as a breakdown of emission trends by Canadian economic sectors. Chapters 3 to 8 provide descriptions

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and additional analysis for each broad emission and removal category according to UNFCCC reporting requirements. Chapter 9 presents a summary of recalculations and planned improvements.

Part 2 of the NIR consists of Annexes 1 to 10, which provide a key category analysis, detailed explanations of estimation methodologies, a comparison of the sectoral and reference approaches in the Energy Sector, quality assurance and quality control procedures, completeness assessments, inventory uncertainty, emission factors, rounding procedures, and a summary of ozone and aerosol precursors.

Part 3 comprises Annexes 11 to 13, which present summary tables of GHG emissions for each provincial and territorial jurisdiction, sector and gas, as well as additional details on the GHG intensity of electricity generation.

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