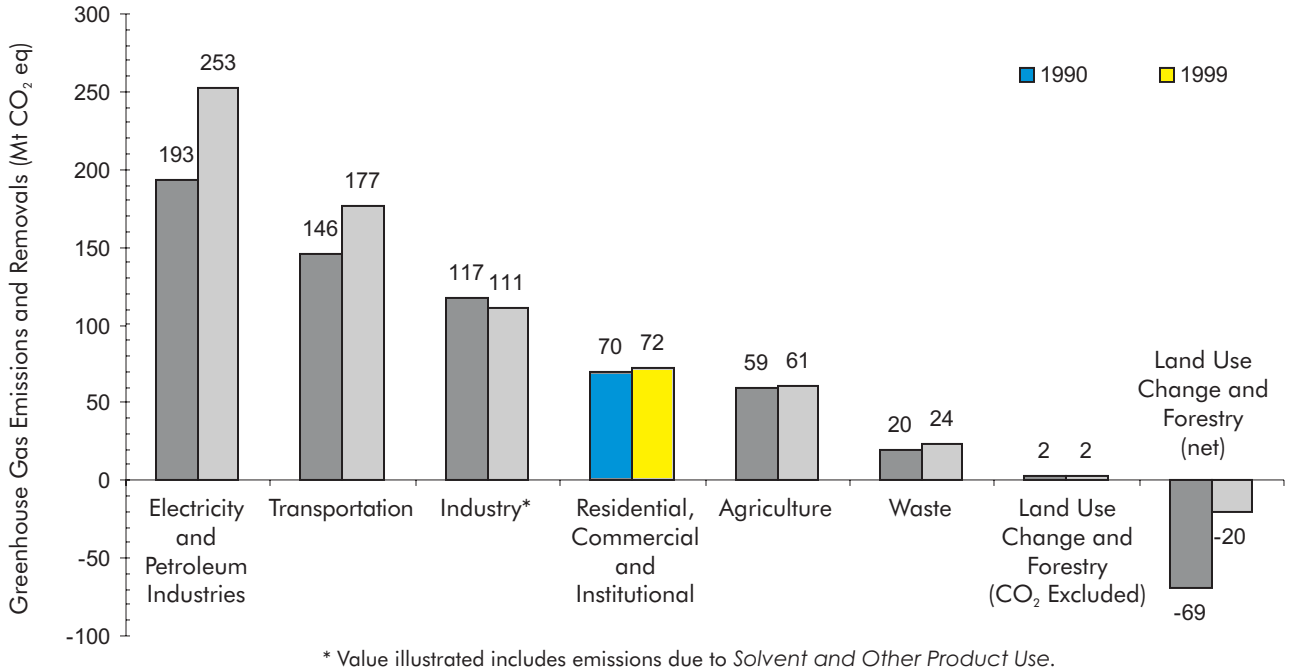
Residential, Commercial & Institutional Sectors: 1990 - 1999

The Residential, Commercial & Institutional (RCI) sector of the Canadian Greenhouse Gas Inventory includes emissions from fuel combustion in buildings for space heating and cooling* (excluding electricity use) and water heating.

- *In 1999,* this sector contributed slightly more than10% of Canada's 699 megatonnes of carbon dioxide equivalent** (Mt CO_2 eq) greenhouse gas emissions. Total emissions in 1999 from this sector were 71.9 Mt - 43 Mt from the Residential sub-sector and 28.9 Mt from the Commercial & Institutional sub-sector.
- *Between 1990 and 1999,* overall greenhouse gas emissions grew from a base of 69.8 Mt. Residential sub-sector emissions declined by 2.3% while Commercial & Institutional sub-sector emissions grew by 12.0%. Changes in emissions can be attributed to:
  - *use of energy*. There has been an increase in energy use because of growth in both sub-sectors. Increased energy use, however, has been offset by mitigating factors that include energy efficiency improvements in building stock and warmer weather; and
  - *substitution of fuel oil by natural gas*, a less carbon intensive fuel.

**Gas fired space cooling is a potential small source of greenhouse gas emissions.*
***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 global warming, with the effect of carbon dioxide being equal to one.*

Figure 1. Canadian Greenhouse Gas Emissions and Removals 1990 and 1999



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

Canada's RCI Sector

Buildings in this sector encompass a range of uses - from detached single family dwellings and apartment buildings, to retail, office and institutional buildings serving business, industry, government, finance, education, health, warehouse, recreation and social service purposes. Omitted from this sector are buildings used in manufacturing, mining and construction (these are included in *Fact Sheet #4 - Industry: 1990-1999*).

The heating or cooling of building interiors, known as space conditioning, and water heating are the sources of this sector's emissions. In addition, they are important energy consuming activities in the operation of buildings. In 1999, about 82% and 65% of total energy demand in the residential and commercial sub-sectors, respectively, were for space conditioning and water heating (Natural Resources Canada, 2001).

The Canadian Greenhouse Gas Inventory (CGHGI)

The Canadian Greenhouse Gas Inventory is developed, compiled, and reported annually by the Greenhouse Gas Division of Environment Canada, and utilizes methods and models developed in-house by engineering and scientific staff, as well as published data, data developed by industry, or methods developed by the Intergovernmental Panel on Climate Change (IPCC, 1997).

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 hydro fluorocarbons (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. The 1999 Trends Fact Sheet Series, while presenting the latest information on Canadian greenhouse gas emissions and removals derived from the latest national inventory, use a modified sector approach to facilitate the use of information by the public.

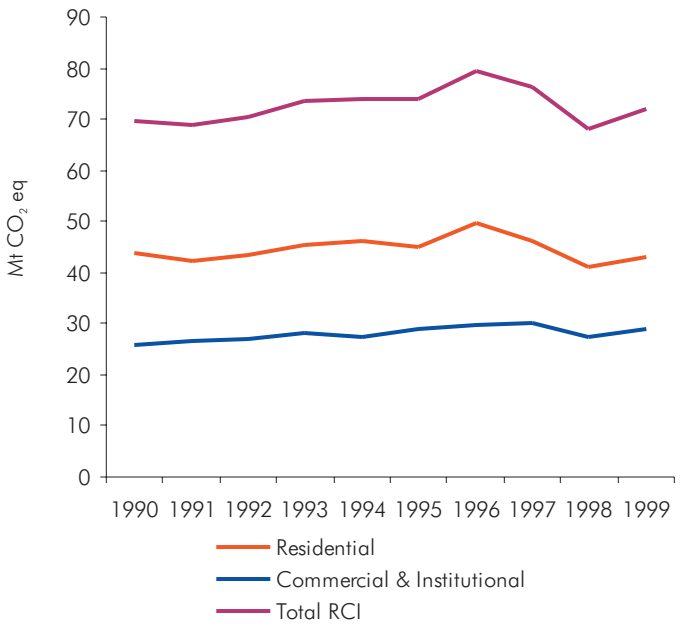
The RCI sector accounts for greenhouse gas emissions from all fossil fuel combustion in buildings. Methane and nitrous oxide emissions from woodfuel combustion for space heat are also minor contributors. The sector overall is not a significant contributor to national emissions: in 1999 its contribution was slightly greater than 10% of the total. Residential heating contributed 6% and Commercial & Institutional 4%.

RCI Emission Trends: 1990 to 1999

Over the period 1990 to 1999, greenhouse gas emission growth in this sector was relatively flat. Emissions from the Residential sub-sector declined by more than 2% while Commercial & Institutional emissions increased by over 12%. In order to understand these trends, it is important to examine the factors influencing fuel use, and hence, emissions.

Figure 2 illustrates the trend in emissions for both the Residential and Commercial & Institutional sub-sectors for the period 1990 to 1999.

Figure 2. Greenhouse Gas Emission Trends in the RCI Sector, 1990 to 1999



RCI Sector and Electricity Emissions

For accounting purposes, Canada's Greenhouse Gas Inventory attributes emissions from electricity only to production at the generation source. Demand for electricity in the RCI sector, whether for space heating or other purposes, is included in *Fact Sheet #2 - Electricity and Petroleum Industries: 1990-1999*.

Trends in emissions can be influenced by four important factors:

1. real estate activity within the sector (e.g. the growth or decline of heated/cooled building space;
2. changes in efficiency of energy use;
3. changes in weather (which would require more or less fuel for heating or cooling); and
4. substitution of fuels with differing carbon intensities.

Growth in Residential and Commercial Activity

The Residential, Commercial and Institutional sub-sectors all experienced significant growth in activity between 1990 and 1999. An estimated 247 million square metres of additional residential floor space and 74 million square metres of commercial floor space were created (Natural Resources Canada, 2001). Without other influences, growth in sector activity may have had the greatest impact on energy use, giving rise to a potential increased energy demand of 377 PJ, or 17% over 1990. The impact on greenhouse gas emissions by this potential increase in energy use, however, was ameliorated by other factors described below.

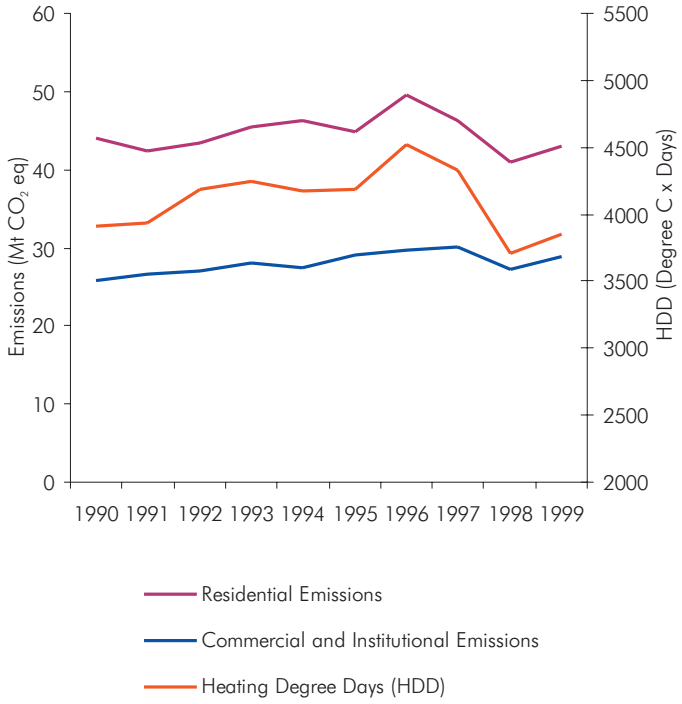
Increases in Energy Efficiency

Energy efficiency increases within buildings (for example, increased insulation and high efficiency furnaces) was the major contributor to dampening overall energy demand over the period. In the Residential sub-sector, estimates are that increases in efficiency decreased potential growth in space heating energy use by at least 75% (Natural Resources Canada, 2001). In the Commercial & Institutional sub-sector, potential growth in all energy use decreased by about 10%. Energy efficiency improvements, therefore, are significant contributors to reducing the growth of greenhouse gas emissions.

Changes in Weather

The other factor influencing energy use, and hence emission trends, is weather. Figure 3 tracks greenhouse gas emission trends in the RCI sector against heating degree days (HDD). From the figure, it is evident that there is a general coincidence in the trends, particularly in the Residential sub-sector.

Figure 3. RCI Sub-sector Trends Related to Heating Degree Days (HDD), 1990 to 1999



In 1999, heating degree days were 1.5% lower than in 1990 (Statistics Canada, #57-003). Residential greenhouse gas emissions were 2.3% lower, while Commercial & Institutional emissions were 12% higher. The Commercial & Institutional sub-sector is less likely to show the influence of heating degree days because of its widespread use of gas-fired absorption air conditioning. In warmer years with lower heating degree days, decreased energy use for heating is offset because the requirement for air conditioning likely increases with more cooling degree days (CDD).

Fuel Substitution

Fuel substitution away from carbon intensive fuels can ameliorate greenhouse gas emissions. This has been the

trend in the RCI sector. Table 1 compares the trends in all fuel use for the RCI sector for the years 1990 and 1999.

There has been a clear trend over the last 10 years for the substitution of fuel oil by natural gas in the RCI sector. While electricity and propane have maintained their contributions to energy used, the natural gas contribution has increased 4% while fuel oil has decreased by the same proportion. The carbon intensity of natural gas is 25% less than that of fuel oil, leading to emission reduction trends.

References

Environment Canada, *Canada's Greenhouse Gas Inventory 1990 - 1999: Emission and Removal Estimation Practices and Methods*, April 2001.

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

Natural Resources Canada, *Office of Energy Efficiency Trends in Canada 1990 to 1999 An Update: Indicators of Energy Use, Energy Efficiency and Emissions*, July 2001.

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

Glossary

Heating Degree Day (HDD): An indicator of winter heating loads. The annual sum of the degrees of average daily temperatures for all days below 18C.

Cooling Degree Day (CDD): An indicator of summer cooling loads. The annual sum of the degrees of average daily temperatures for all days above 18C.

Carbon intensity: The proportion of molecular carbon to the energy content of a fuel. Since nearly all carbon is released as a gas on combustion of fuels, high carbon intensity fuels produce more CO_2 per unit of heating than low intensity fuels.

Table 1. Trends in Fuel Use in the RCI Sector: 1990 and 1999

	1990		1999	
Fuel	Energy (PJ)	Contribution	Energy (PJ)	Contribution
Natural Gas	915.5	44%	1,054.4	48%
Propane	35.9	2%	44.8	2%
Electricity	857.5	41%	915.9	41%
Fuel Oil	259.7	13%	195.0	9%
TOTAL	2,258.4	100%	2,210.0	100%

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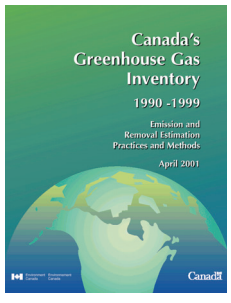

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