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# Canadian Environmental Sustainability Indicators: Highlights

2007



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## Note of appreciation

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# Introduction

The health of Canadians and their social and economic well-being are highly dependent on the quality of their environment. One way to assess environmental quality is to use indicators that convey complex information in a simple form. The Canadian Environmental Sustainability Indicators provide an indication of the health of our environment in much the same way as the gross domestic product (GDP) and other measures provide a sense of the health of the economy. Over the long term, the intent of the Canadian Environmental Sustainability Indicators initiative is to supplement traditional social and economic measures with information that will allow Canadians to better understand the relationships that exist among the economy, the environment, and human health and well-being.

This is the third annual Canadian Environmental Sustainability Indicators Highlights report. It presents key findings from the Canadian Environmental Sustainability Indicators 2007 report. The full 2007 report provides more analysis on indicators and socio-economic factors than previous reports and is based on the best national information available on three environmental issues of high importance to Canadians: air quality, greenhouse gas emissions and freshwater quality. In this year's report, the three indicators have been updated with 2005 data.

The **air quality indicators** track measures of exposure of Canadians to ground-level ozone and fine particulate matter (PM<sub>2.5</sub>). These are key components of smog and two of the most pervasive and widely spread air pollutants. Exposure to these pollutants can be harmful. Both the ozone and PM<sub>2.5</sub> exposure indicators are population-weighted average concentrations observed at monitoring stations across Canada during the warm season (April to September).

The **greenhouse gas emissions indicator** tracks the annual Canadian releases of the six greenhouse gases (carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, perfluorocarbons and hydrofluorocarbons) that are the major

contributors to climate change. The indicator comes directly from the National Inventory Report prepared annually by Environment Canada for the United Nations Framework Convention on Climate Change.

The **freshwater quality indicator** uses the Water Quality Index endorsed by the Canadian Council of Ministers of the Environment to summarize the status of surface freshwater quality. Quality is assessed by examining the extent to which water quality guidelines for the protection of aquatic life (plants, invertebrates and fish) are being met at selected lake and river monitoring sites throughout Canada.

This report is the result of an ongoing collaboration between Environment Canada, Statistics Canada and Health Canada. It has also greatly benefited from the cooperation and input of all the provinces and territories, which share the responsibility for environmental management in Canada. While there are policies and programs designed to address the issues tracked by the indicators, this Canadian Environmental Sustainability Indicators report is not intended to provide a summary or evaluation of these policies and programs.



# Air quality

## What is the issue?

Ground-level ozone and fine particulate matter (PM<sub>2.5</sub>) are two key components of smog and have important negative impacts on human health, the natural environment and economic performance. Studies indicate that adverse health effects can occur even with low concentrations of these pollutants in the air.

## What is happening?

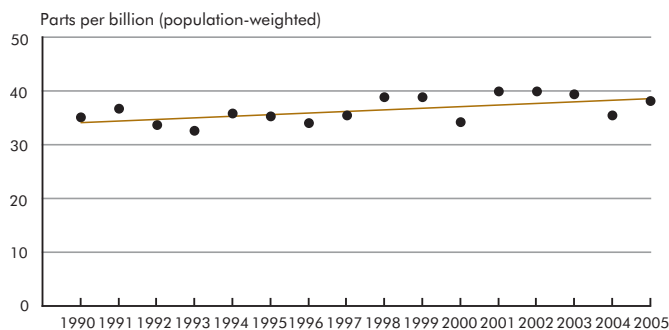
The air quality indicators track measures of the exposure of Canadians to ground-level ozone and fine particulate matter (PM<sub>2.5</sub>) during the warm season (April 1 to September 30).

- Nationally, the ozone exposure indicator increased an average of 0.8% per year from 1990 to 2005. This resulted in an overall increase of approximately 12% for this time period.<sup>1</sup> In 2005, ozone concentrations were highest at stations in southern Ontario; southern Quebec and Alberta also had many stations with high concentrations.
- Between 1990 and 2005, the ozone exposure indicator increased only in two regions—in southern Ontario by approximately 17%<sup>2</sup> and in southern Quebec by approximately 15%.<sup>3</sup> In other regions, the ozone exposure indicator showed no statistically significant increasing or decreasing trends.
- The PM<sub>2.5</sub> exposure indicator showed no statistically significant increasing or decreasing trends, either nationally or regionally between 2000 and 2005. The highest PM<sub>2.5</sub> concentrations were measured at stations in southern Ontario and southern Quebec in 2005.

## Why is it important?

Ground-level ozone and PM<sub>2.5</sub> have been linked to negative health impacts ranging from minor respiratory problems to cardiovascular disease, hospitalizations and premature death. For example, based on data from eight Canadian cities, Health

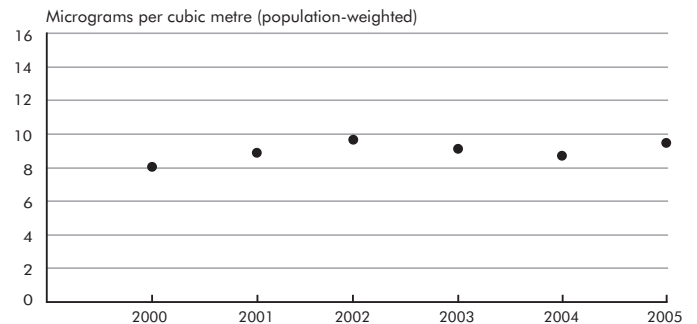
### Ground-level ozone exposure indicator, Canada, 1990 to 2005



Notes: The trend line represents an average rate of change of 0.8% per year. From 1990 to 2005, the indicator shows a statistically significant increase of 12% (plus or minus 10 percentage points, resulting in an increase ranging from 2% to 22% at a 90% confidence level). Ambient data collected from 76 monitoring stations.  
Sources: National Air Pollution Surveillance (NAPS) Network and the Canadian Air and Precipitation Monitoring Network (CAPMoN); Statistics Canada Census of Population.

1. Plus or minus 10 percentage points, resulting in an increase ranging from 2% to 22% at a 90% confidence level.
2. Plus or minus 13 percentage points, resulting in an increase ranging from 4% to 30% at a 90% confidence level.
3. Plus or minus 12 percentage points, resulting in an increase ranging from 3% to 27% at a 90% confidence level.

### Fine particulate matter (PM<sub>2.5</sub>) exposure indicator, Canada, 2000 to 2005



Notes: No trend line is presented because there has been no statistically significant increase or decrease from 2000 to 2005 at a 90% confidence level. Ambient data collected from 65 monitoring stations.  
Sources: National Air Pollution Surveillance (NAPS) Network; Statistics Canada Census of Population.

Canada has estimated that 5900 premature deaths each year in these cities are attributable to air pollution. Related economic effects include absenteeism, lower labour force participation and increased health care costs. Ecological and related economic impacts are also substantial. For example, elevated concentrations of ozone reduce plant growth and yield, decreasing productivity in agriculture and forestry.

## Why is it happening?

Ground-level ozone is formed by chemical reactions involving principally nitrogen oxides (NO<sub>x</sub>) and volatile organic compounds (VOC) in the presence of sunlight. Human activities contribute to its formation by increasing the concentrations of NO<sub>x</sub> and VOC, primarily through the burning of fossil fuels in sectors such as transportation, industry and electricity generation. Production and use of paints, cosmetics, and the evaporation of liquid fuels and solvents also add VOC to the air.

In addition to the presence of local pollutant emissions, ozone concentrations are also affected by the long-range transport of pollutants from other regions and countries, and by weather conditions, such as temperature and wind direction. All these factors may explain the increasing trends of ozone exposure in southern Ontario and southern Quebec.

PM<sub>2.5</sub> is emitted directly as a pollutant or is formed in the air as a secondary pollutant from sulphur dioxide, NO<sub>x</sub>, VOC and ammonia. The actual contribution of a specific pollutant to PM<sub>2.5</sub> concentrations in the air varies by location, time of year and prevailing meteorological conditions. On an annual basis, direct PM<sub>2.5</sub> emissions from industrial sectors are the largest, followed by wood burning for home heating, and transportation. Dust from wind erosion and smoke from forest fires are natural sources of PM<sub>2.5</sub> and contribute to total emissions.

# Greenhouse gas emissions

## What is the issue?

Greenhouse gas emissions from human activities enhance the Earth's natural greenhouse effect, thereby contributing to global climate change. It is anticipated that the changing global climate could have a range of significant impacts, including on extreme weather events, natural ecosystems, human health and economic activity.

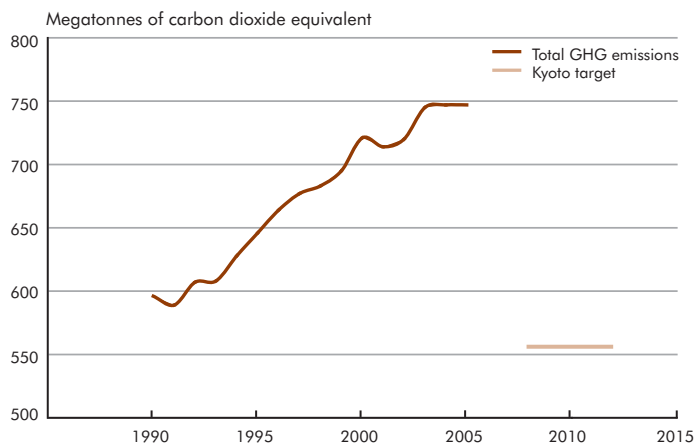
## What is happening?

- In 2005, Canada's total greenhouse gas emissions were estimated to be 747 megatonnes of carbon dioxide equivalent, up 25% from 1990.
- Canada's 2005 emissions were 33% above the Kyoto Protocol target of 563 megatonnes, which is 6% below the 1990 baseline level.
- Recently (2003 to 2005), the growth in emissions has slowed, due primarily to a significant reduction in emissions from electricity production (reduced coal and increased hydro and nuclear generation), coupled with reduced demand for heating fuels due to warm winters and a reduced rate of increase in fossil fuel production.
- Overall, energy production and consumption contributed about 82% of Canada's total greenhouse gas emissions in 2005. From 1990 to 2005, these emissions rose by 29%, accounting for 90% of the growth in Canada's total greenhouse gas emissions over the 16-year period.
- The amount of greenhouse gases emitted per unit of economic activity was 17.8% lower in 2005 than in 1990. Increases in overall economic activity, however, resulted in increases in total energy use and greenhouse gas emissions.

## Why is it important?

The consensus of the Intergovernmental Panel on Climate Change is that greenhouse gas emissions caused by human activity are having a discernible impact on the climate. Canadians are vulnerable to the resulting global climate changes. A rise in global temperatures is expected to lead to more severe storm patterns, more heat waves, changes in precipitation, a rise in sea levels, and regional droughts and

## Greenhouse gas (GHG) emissions, Canada, 1990 to 2005



Source: Environment Canada. 2007. *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada, 1990-2005*. Greenhouse Gas Division (forthcoming).

flooding. Climate change impacts will be particularly pronounced in Canada's north, and some changes are already being observed. For example, the extent of sea ice cover can be expected to decline, which will affect transportation, wildlife distributions and traditional hunting practices in the north.

On a national basis, agriculture, forestry, tourism and recreation could be affected. Climate change is also projected to increase risks to human health by leading to a rise in cases of heat stress, respiratory illnesses, and the transmission of insect and waterborne diseases, placing additional pressures on health and social support systems if significant adaptation measures are not put in place.

## Why is it happening?

Naturally occurring greenhouse gases help regulate the Earth's climate by trapping heat in the atmosphere and reflecting it back to the surface. However, human activities have amplified this natural process.

Greenhouse gas emissions from the oil, gas and coal industry increased by 48% from 1990 to 2005, reflecting rapid growth in the production and export of crude oil and natural gas. Emissions from road transportation rose 33% over the same period, mainly because of a shift in consumer preference from automobiles to less fuel-efficient minivans, sport utility vehicles and small pickup trucks, as well as an increase in heavy truck transport. Emissions from thermal-electric power and heat generation grew by almost 37% from 1990 to 2005, driven primarily by a rising demand for electricity and an increase in the use of fossil fuels to generate electricity.



# Freshwater quality

## What is the issue?

Water quality in Canada is under pressure from a range of sources, including human settlement, agriculture and industrial activities and household behaviour. Degraded water quality can affect both aquatic life and human uses of water for industry, recreation, and agriculture, and as a source of drinking water.

## What is happening?

This indicator, as a water quality index based on many chemical and physical parameters, assesses surface freshwater quality with respect to protecting aquatic life (e.g., fish, invertebrates and plants). It does not assess the quality of water for human consumption and use. The data available are not sufficient to report national trends for the indicator at this time. The indicator is based on information gathered from 2003 to 2005.

- Freshwater quality for the 359 monitoring sites in southern Canada was rated as "good" or "excellent" at 44% of the sites, "fair" at 33% and "marginal" or "poor" at 23%.
- Freshwater quality measured at 36 monitoring sites in northern Canada was rated as "good" or "excellent" at 56% of the sites, "fair" at 31% and "marginal" or "poor" at 14%.
- Phosphorus, a nutrient mainly derived from human activities and a key driver of the water quality index, is a major concern for surface freshwater quality in Canada. Phosphorus levels in southern Canada exceeded limits set under the water quality guidelines for aquatic life over half the time at 127 of 344 monitoring sites.

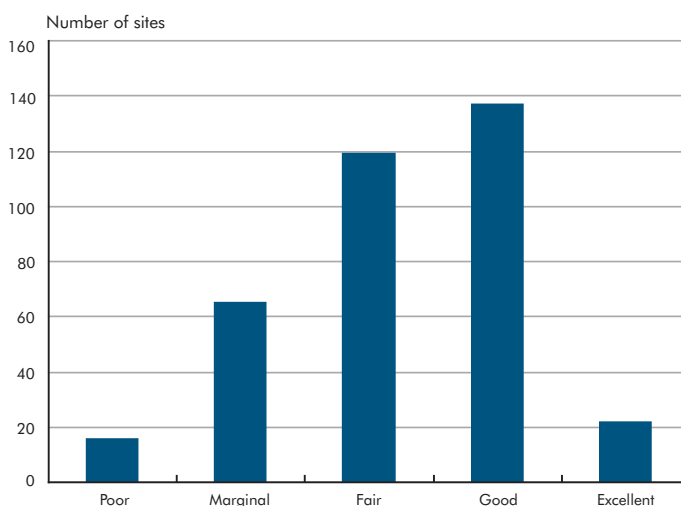
Other water quality indicators, information and analysis for drinking water sources, agricultural use and recreational use are being developed as part of the freshwater quality indicator series.

## Why is it important?

Water of sufficient quality and in adequate quantities is fundamental to healthy ecosystems, human health and



## Status of freshwater quality at sites in southern Canada, 2003 to 2005



Notes: The results are for surface freshwater quality with respect to protecting aquatic life. They do not assess the quality of water for human consumption and use. Number of sites is 359. Observations for northern Canada are not included.  
Sources: Data assembled by Environment Canada and Statistics Canada from federal, provincial, territorial and joint water quality monitoring programs.

economic performance. Degradation of water quality can affect both aquatic life and human uses of water. For example, high concentrations of nitrogen and phosphorus in the water may result in excessive aquatic plant growth, such as algal blooms, which reduce the amount of dissolved oxygen available for fish and other aquatic animals. Some algal blooms can also be toxic, killing livestock and resulting in the closure of shellfish growing areas, and represent a human health risk. Degraded water quality can also affect economic activities such as freshwater fisheries, tourism and agriculture, or recreational uses of water such as swimming.

## Why is it happening?

Manufacturing and service industries, institutions and households discharge hundreds of different substances, directly or indirectly, into rivers and lakes. At least 115 000 tonnes of pollutants were directly discharged to Canada's surface waters (both freshwater and coastal) in 2005. Many pollutants also make their way into water bodies indirectly after being released into the air or onto the land. Runoff from agricultural lands and urban areas with high concentrations of nitrogen and phosphorus can also degrade water quality, as can changes to water flows. Natural phenomena such as seasonal snow melt and heavy rainfall can also be responsible for water quality measurements not meeting guidelines; for example, they can increase levels of suspended sediments that are often high in nutrients and metals.

# Linking the indicators to society and the economy

## What is the issue?

Social and economic forces are important drivers influencing changes in the indicators. For this reason, an important goal of the Canadian Environmental Sustainability Indicators initiative is to examine the linkages between these environmental indicators and socio-economic factors that influence trends in the indicators.

## What is happening?

- Population size, distribution and density play a major role in determining the impacts that human activities have on the environment. Between 1990 and 2005, Canada's population grew by 17%, from 27.7 million people to 32.3 million. With growing numbers of people living in and around urban areas, the potential for impacts on local and regional air and surface water quality are multiplied. From 1991 to 2006, urban populations increased by 21%, while rural populations decreased by 2%.
- Growth in economic activity brings benefits in the form of increased income, but can also lead to greater pressure on the environment. For instance, economic growth has led to greater energy use by industries, which in turn has resulted in increased emissions of greenhouse gases and air pollutants. Nevertheless, some large energy consuming industries are becoming more energy efficient, thereby offsetting some of the growth in emissions. For instance, the manufacturing industry reduced its energy requirements to produce a unit of goods and services by 33% between 1990 and 2002.<sup>4</sup> However, total growth in sales of manufactured goods and services outpaced the energy-efficiency improvements, resulting in an overall 4% increase in total manufacturing energy use.
- Consumption behaviours also have an effect on the environment. For example, close to one fifth (17%) of the energy consumed in Canada is used directly by households to heat and power their homes, something that impacts both air quality and emissions of greenhouse gases.

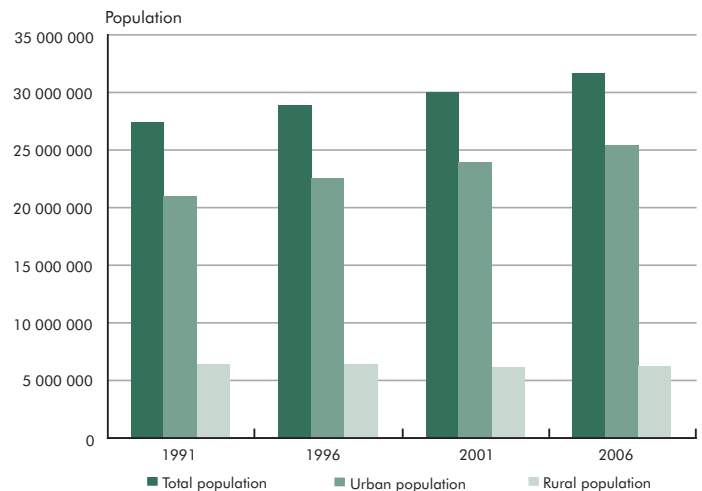
## A closer look at household behaviours

The behaviours of individual Canadians have an important effect on the environment. The 2006 *Households and the Environment Survey*, conducted under the Canadian Environmental Sustainability Indicators initiative, measured many household behaviours related to the environment and provides context to the indicators in this report.

The survey findings show that, since 1994, Canadians' environmental priorities and concerns have led to some changes in household behaviours:

- Over 55% of Canadian households now use compact fluorescent bulbs. Between 1994 and 2006, the proportion using at least one compact fluorescent light bulb almost tripled.

Total, urban and rural population, Canada, 1991 to 2006



Source: Statistics Canada, Census of Population.

- Forty percent of households now have a programmable thermostat, more than double the number in 1994. Of those households who owned this type of thermostat and who programmed it, two out of three turned down the heat at night. On the other hand, 17% of the households equipped with programmable thermostats had not, in fact, programmed them.
- Use of water-saving devices, such as water-saving showerheads and low-flow toilets, is increasing. For example, 54% of Canadian households reported having a water-saving showerhead as opposed to 42% in 1994.

However, other behaviours observed through the survey indicate that environmental values are still competing with the practical realities of personal time use, comfort and convenience.

- The use of chemical pesticides, which can affect water quality, was down only slightly in 2006 from 1994 levels. Also, over 39% of households flushed down the drain or put in the garbage their leftover pharmaceutical products.
- During the warmer months, 73% of Canadians working outside the home travel to work by motor vehicle, 14% walk or cycle, and 10% use public transit. In colder months, the proportion of commuters who travel by car increased to 81%. In both seasons, well over half of all commuters travel alone to work in a motor vehicle. This has implications for both air quality and emissions of greenhouse gases.

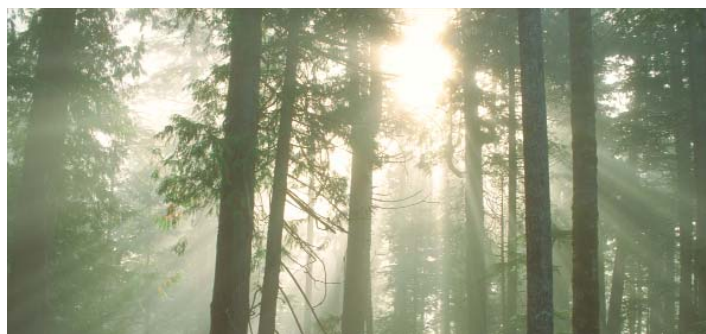
4. Calculation uses real gross output (the value of an industry's sales corrected for inflation).

# Conclusion

This report shows that pressure on Canada's environment is steady or increasing, and highlights some of the potential consequences for the health and well-being of Canadians and our economic performance. The trends for air quality and greenhouse gas emissions are continuing concerns, while the water quality results show that guidelines for protecting aquatic life are not being met, at least occasionally, at many of the selected monitoring sites across the country.

## Where can I get more information?

The Canadian Environmental Sustainability Indicators documents can be accessed electronically on the Government of Canada's website on Sustaining the Environment and Resources for Canadians ([www.environmentandresources.ca/indicators](http://www.environmentandresources.ca/indicators)) and the Statistics Canada website ([www.statcan.ca/bsolc/english/bsolc?catno=16-252-X](http://www.statcan.ca/bsolc/english/bsolc?catno=16-252-X)). These sites also contain background information on each of the indicators—the science, the data, the methods and the indicators' limitations. Online tools enable users to examine regional and sectoral details on the indicators, while an online socio-economic information report also provides contextual information on socio-economic factors that may influence the indicators.



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