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Canadian Environmental Sustainability Indicators: Highlights

2006

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Note of appreciation

Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued cooperation and goodwill.

Introduction

The health of Canadians and the country's social and economic progress are highly dependent on the quality of the environment. Recognizing this, efforts are being directed towards providing more accessible and integrated information on society, the economy and the environment to help guide the actions of Canadians and their governments.

Environment Canada, Statistics Canada and Health Canada are working together to further develop and communicate national environmental indicators of air quality, greenhouse gas emissions and freshwater quality—measuring sticks that can track progress by governments, industries and individuals in protecting and improving the environment. These indicators were first reported in Canadian Environmental Sustainability Indicators (CESI) 2005 and have been updated and further developed in this year's report.

The air quality indicators reflect the potential for long-term exposure of Canadians to ground-level ozone and fine particulate matter ($PM_{2.5}$), key components of smog and two of the most common and harmful air pollutants to which people are exposed. Both the ozone and $PM_{2.5}$ indicators are population-weighted estimates of average warm-season concentrations of these pollutants observed at monitoring stations across Canada.

The greenhouse gas emissions indicator tracks the annual releases of the six greenhouse gases that are the major contributors to climate change. The indicator comes directly from the greenhouse gas inventory report prepared by Environment Canada for the United Nations Framework Convention on Climate Change.

The freshwater quality indicator reports the status of surface freshwater quality at selected monitoring sites across the country, including the Great Lakes and, for the first time in this report, northern Canada. The indicator uses the Water Quality Index, endorsed by the Canadian Council of Ministers of the Environment, to summarize the extent to which water quality guidelines for the protection of aquatic life (plants, invertebrates and fish) are exceeded in Canadian rivers and lakes. The focus on protection of aquatic life provides the most broadly based indicator of water quality, best reflecting the level of ecosystem health in freshwater bodies across Canada.

These Canadian Environmental Sustainability Indicators are designed to supplement traditional social and economic measures, such as employment levels and the Gross Domestic Product, so that Canadians can better understand the relationships that exist among the economy, the environment and human health and well-being. They are intended to assist those in government who are responsible for developing policy and measuring performance, as well as offering all Canadians information about environmental sustainability in Canada.

Air quality

What is the issue?

Ground-level ozone and fine particulate matter ($PM_{2.5}$) are two key components of smog and have significant negative impacts on human health, on the natural environment and, consequently, on economic performance. Human exposure to these pollutants is of concern because there are no established thresholds below which these pollutants are safe and do not pose a risk to human health.

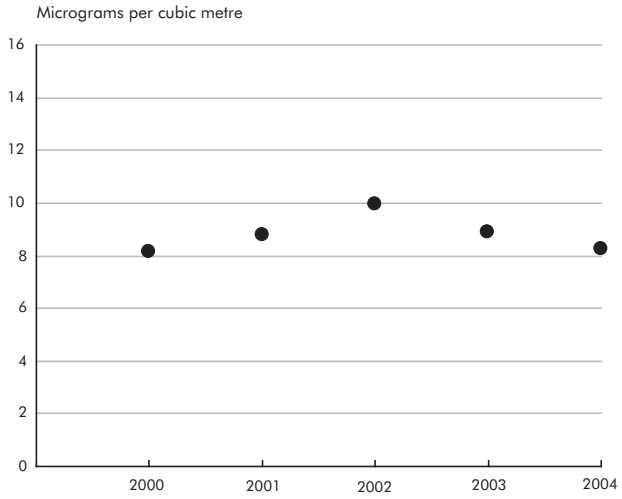
What is happening?

- At the national level, from 1990 to 2004, the ground-level ozone indicator showed year-to-year variability with an average increase of 0.9% per year.
- In 2004, ground-level ozone values were the highest at monitoring stations in southern Ontario, followed by Quebec/eastern Ontario. Southern Ontario has exhibited an increasing trend since 1990, while other regions showed no noticeable increase or decrease.
- The highest $PM_{2.5}$ levels for 2004 were in southern Ontario, although some areas in eastern Quebec also showed high levels. There was no discernible national trend for $PM_{2.5}$ during the period 2000 to 2004.

Why is it important?

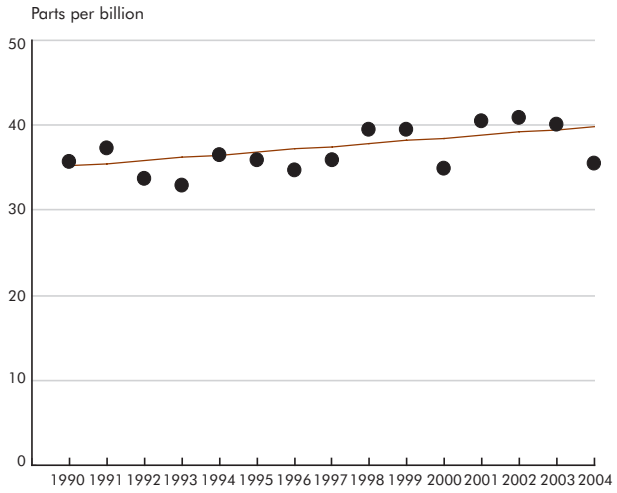
Ground-level ozone and $PM_{2.5}$ have been linked to health impacts ranging from minor respiratory problems to cardiovascular disease, hospitalizations and premature death. Related economic effects include absenteeism, lower labour force participation and increased health care costs.

Fine particulate ($PM_{2.5}$) indicator, Canada, 2000 to 2004



Notes: The indicator is a population weighted estimate, based on data from 63 monitoring stations across Canada.
Sources: Environment Canada, National Air Pollution Surveillance Network Database; Statistics Canada, Environment Accounts and Statistics Division.

Ground-level ozone indicator, Canada, 1990 to 2004



Notes: The indicator is a population weighted estimate, based on data from 76 monitoring stations. The trendline represents the average rate of change based on the Sen method.
Sources: Environment Canada, National Air Pollution Surveillance Network Database; Statistics Canada, Environment Accounts and Statistics Division.

Why is it happening?

Ozone is formed by chemical reactions involving nitrogen oxides (NO_X) and volatile organic compounds (VOC) in the presence of sunlight. Human activities contribute to the formation of ground-level ozone by increasing the concentrations of NO_X and VOC, primarily through the burning of fossil fuels in motor vehicles, homes, industries and power plants. Paints, cosmetics and the evaporation of liquid fuels and solvents also add VOC to the air. Ozone concentrations are affected not only by local activities, but also by weather conditions and the movement of pollutants from other regions and countries.

The sources of $PM_{2.5}$ are varied. NO_x, sulphur dioxide, ammonia and VOC emissions all contribute to its formation and their interaction is affected by meteorological conditions. $PM_{2.5}$ is also emitted directly as a pollutant. Transportation and industrial emissions are the main contributors, but wood burning for home heating is also a significant source, especially in the winter. Dust from wind erosion and ash from forest fires are natural sources of $PM_{2.5}$ and contribute to the overall total.

Greenhouse gas emissions

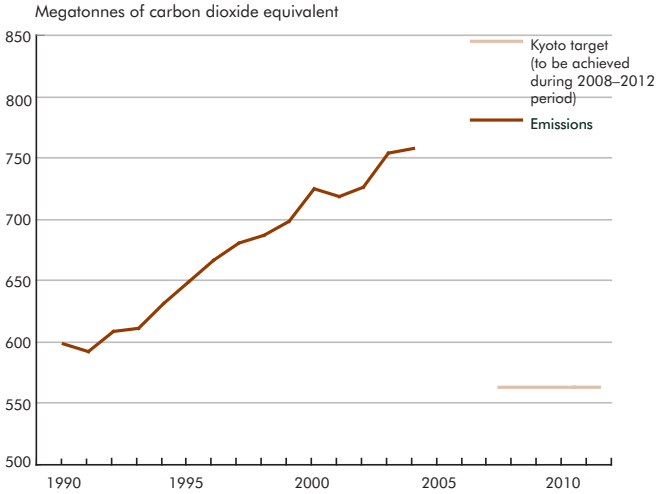
What is the issue?

Greenhouse gas emissions from human activities enhance the Earth's natural greenhouse effect, thereby contributing to global climate change.

What is happening?

- In 2004, Canada's total greenhouse gas emissions reached an estimated 758 megatonnes of carbon dioxide equivalent, up 27% from 1990.
- Canada's 2004 emissions were 35% above the target of 6% below the 1990 baseline level to be achieved in the period 2008 to 2012 under the Kyoto Protocol.
- Emissions per person rose 10% from 1990 to 2004, while emissions per unit of Gross Domestic Product fell 14%.
- The production and consumption of energy (including road transportation, the oil and gas industries and fossil fuel-fired electricity generation) accounted for 82% of total Canadian emissions in 2004 and 91% of the growth in emissions from 1990 to 2004.
- Alberta and Ontario had the highest emissions of all provinces in 2004.

Greenhouse gas emissions, Canada, 1990 to 2004



Source: Environment Canada. 2006a. *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada. 1990–2004*. Greenhouse Gas Division.

Why is it important?

Canadians are vulnerable to global climate changes that may result from increasing greenhouse gas emissions. A rise in global temperatures could lead to severe storm patterns, more heat waves, changes in precipitation, a rise in sea levels, and regional droughts and flooding. In Canada's north, for example, the extent of sea ice can be expected to decline, which will affect northern travel, wildlife distributions and traditional hunting practices. On a national basis, agriculture, forestry, tourism and recreation could be affected, as could supporting industries and towns. Climate change is also projected to impact human health by leading to increases in cases of heat stress, respiratory illnesses and transmission of insect- and waterborne diseases, placing additional stresses on the health and social support systems.

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.

The production and consumption of energy, including sources such as transportation, electricity generation, space heating and fossil fuel production and consumption, rose 30% from 1990 to 2004, and accounted for most (82%) of total greenhouse gas emissions in 2004. Greenhouse gas emissions from the oil, gas and coal industry increased 49% from 1990 to 2004, reflecting rapid growth in the production and export of crude oil and natural gas. Emissions from road transportation rose 36% over the same period as the types of personal vehicles shifted from automobiles to minivans, sport utility vehicles and small pickup trucks. Emissions from thermal electricity and heat production grew 37% from 1990 to 2004, driven primarily by a rising demand for electricity and an increase in the use of fossil fuels for electricity generation relative to non-emitting sources such as nuclear and hydro.

Freshwater quality

What is the issue?

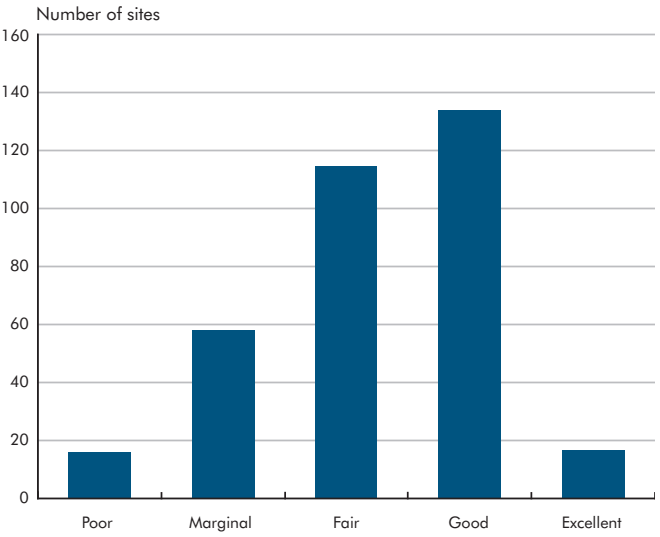
Water quality in Canada is under pressure from a range of sources, including human settlement, agriculture and industrial activities. Degraded water quality can affect both aquatic life and human uses of water for recreation, agriculture, and as source water for drinking.

What is happening?

This indicator assesses surface freshwater quality with respect to protecting aquatic life (e.g., fish, invertebrates and plants). Based on information gathered from 2002 to 2004:

- Freshwater quality at 340 selected monitoring sites across southern Canada was rated as "good" or "excellent" at 44% of the sites, "fair" at 34% and "marginal" or "poor" at 22%.
- Freshwater quality at 30 sites across northern Canada was rated as "good" or "excellent" at 67% of the sites, "fair" at 20% and "marginal" or "poor" at 13%.
- Freshwater quality measured in 2004 and 2005 in the Great Lakes was rated as "good" or "excellent" for Lake Superior, Lake Huron, Georgian Bay, and eastern Lake Erie, "fair" for central Lake Erie, and "marginal" for western Lake Erie and Lake Ontario.

Status of freshwater quality at sites in southern Canada, 2002 to 2004



Notes: Observtions for the Great Lakes and northern Canada are not included.
Source: Data assembled by Environment Canada from federal, provincial and joint water quality monitoring programs.

Why is it important?

Good quality water in adequate quantities is fundamental to healthy ecosystems, human health and economic performance in Canada. Degradation of water quality can affect both aquatic life and human uses of water. For example, high concentrations of nutrients (e.g., nitrogen and phosphorus) may result in excessive plant growth, which reduces the amount of dissolved oxygen available for fish and other aquatic animals. Degraded water quality can also affect economic activities such as freshwater fisheries, tourism and agriculture.

Why is it happening?

Primary manufacturing and service industries, institutions and households discharge hundreds of different substances, directly or indirectly, into rivers and lakes. Many pollutants also make their way into water bodies indirectly after being released into the air or onto the land. Untreated runoff from agricultural lands and urban areas can also degrade water quality, as can changes to water flows. Natural phenomena such as glacial flows, seasonal snow melt and heavy rainfall can also lead to high levels of suspended sediments that are rich in nutrients and metals.

Connecting the indicators

Each of the indicators in CESI 2006 focuses on separate issues and reflects different time periods and geographic scales. They are, however, connected in some fundamental ways:

- Many of the same social and economic forces drive the changes in the indicators.
- Some of the same substances impact all three indicators.
- The indicators reflect stresses in many of the same regions of the country.

Population size, distribution and density play a major role in determining the impacts that human activities have on the environment. Between 1990 and 2004, Canada's population grew by 15%, from 27.7 million people to 32.0 million.

Consumption behaviours are also an important factor. For example, the current trend towards larger road vehicles has had a significant impact on the emission of air pollutants. Income and prices are two of the key drivers of these behaviours, but climate, geography, trends in housing size and density, and the adoption of technology also play important roles by affecting how much energy or water Canadians consume.

The structure of the economy and distribution of activities across the country are other factors which influence the trends in the indicators, both nationally and regionally. Each industry has different impacts in terms of water usage and pollutant emissions. Service industries (trade, transportation, travel and communications) make up 68% of Canada's GDP, while goods-producing industries (manufacturing, construction and resource industries) account for the remainder.

Real Gross Domestic Product (GDP), which measures the total value of goods and services produced in Canada corrected for inflation, increased by 47% from 1990 to 2004. Over the same period, total primary energy consumption increased by only 26%, indicating a change in the structure of the economy towards service industries as well as improved energy efficiency.

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Conclusion

The 2006 indicator results provide evidence of increased pressure on Canada's environmental sustainability, the health and wellbeing of Canadians, and the potential consequences for our long-term economic performance. The trends for air quality and greenhouse gas emissions are pointing to greater threats to human health and the planet's climate, while the water quality results show that guidelines are being exceeded, at least occasionally, at many of the selected monitoring sites across the country.

Linking the indicators and connecting them to other socio-economic and environmental information can guide policy decisions that better address economic performance, quality of life and environmental sustainability. A key consideration is the socio-economic costs of pollution. For example, Health Canada has estimated, based on data from eight cities, that 5900 premature deaths each year in these cities are attributable to air pollution (Judek et al. 2004). Economists have also tried to estimate the social costs of poor health due to air pollution in Canada. A monetary estimate of these impacts, including health care costs, lost productivity, and pain and suffering, runs to the billions of dollars annually (Chestnut et al. 1999).

Of course, there are also direct costs associated with reducing greenhouse gas emissions and water and air pollution. Canadian companies have substantially increased their spending to protect the environment with investments by primary and manufacturing industries reaching $6.8 billion in 2002, a 24% increase over expenditures in 2000. Much of this increase resulted from responses to new environmental regulations and industry's effort to reduce air emissions such as greenhouse gases.

What is next?

Canadian Environmental Sustainability Indicator reports are produced annually, based on a continually improving set of indicators, with increasingly robust analyses to track the changes in water quality, air quality and GHG emissions in Canada. Future reports will benefit from new surveys, enhanced monitoring capabilities, new scientific knowledge and guidelines, and improved data management and analytical methods.

This year's report has set the indicators in a socio-economic context. However, more work is needed to complete the transition from reporting these indicator results separately to reporting them as a set that is integrated with other information on the environment, measures of economic performance and indices of social progress. The long-term goal is improved decision-making that fully accounts for environmental sustainability.

Where can I get more information?

This publication highlights key findings from the Canadian Environmental Sustainability Indicators 2006 report. The full report provides more detail on each indicator and the links among them. It is available electronically on the Government of Canada website on Sustaining the Environment and Resources for Canadians (www.environmentandresources.ca) and the Statistics Canada website (www.statcan.ca). These sites also contain background information on each of the indicators — the science, the data, the methods and the limitations.

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