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POPULATION EXPOSURE TO OUTDOOR AIR POLLUTANTS

CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

Canada

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CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

POPULATION EXPOSURE TO OUTDOOR AIR POLLUTANTS

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Table of contents

List of Figures

List of Tables

Population exposure to outdoor air pollutants

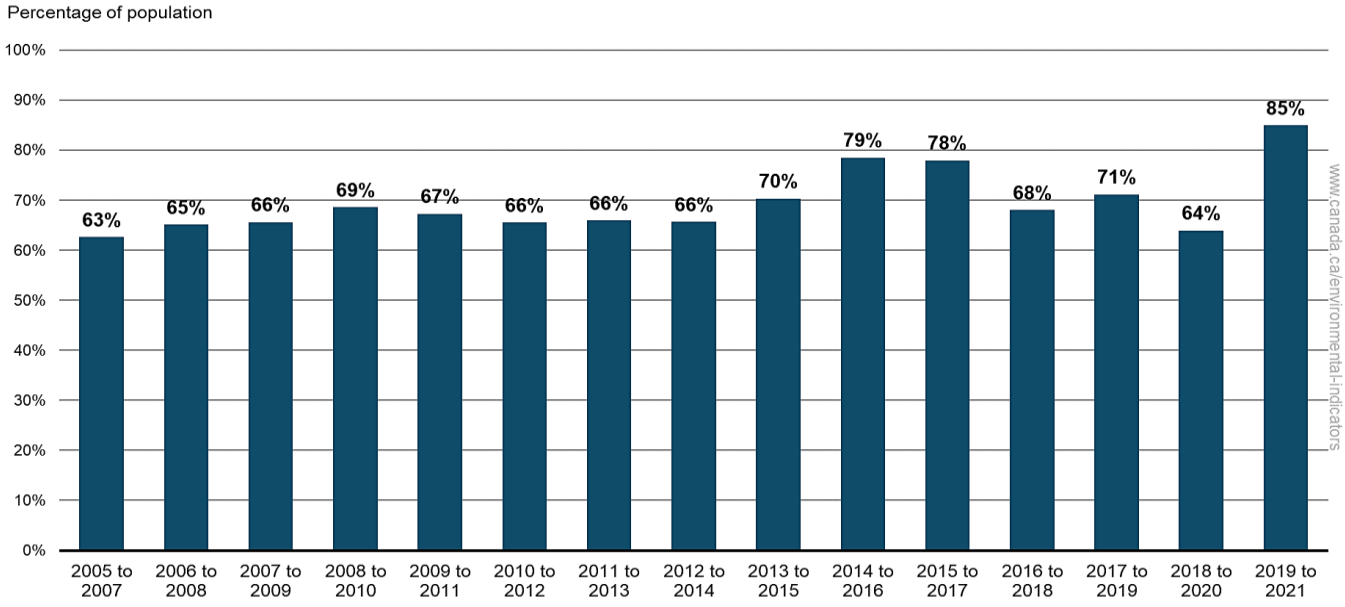
Breathing in air pollutants can contribute to health issues such as asthma, cardiovascular diseases and other illnesses causing premature mortality. The Canadian Ambient Air Quality Standards (CAAQS, the standards) are health- and environmental-based outdoor air quality objectives for pollutant concentrations in the air.[1] They are designed to better protect human health and the environment from air pollution, and to promote continuous improvement in air quality across Canada. This indicator tracks the percentage of the population living in Canadian regions where concentrations of outdoor air pollutants were less than or equal to the 2020 standards.[2]

Key results

In the most recent reporting period (2019 to 2021), 85% of Canadians lived in areas where outdoor concentrations of air pollutants were within the standards.

- This represents an improvement on the 64% established for the previous period (2018 to 2020), a period largely influenced by the 2018 wildfires in British Columbia (1.36 million hectares burned, the largest area on record for the province) and in the United States that caused standards to be exceeded in Alberta and British Columbia.
- This is not only an improvement on the 63% established for the first period (2005 to 2007) but also the highest proportion recorded since this reference period.[3]

Figure 1. Percentage of Canadians living in areas where outdoor concentrations of air pollutants were at or below the 2020 Canadian Ambient Air Quality Standards, Canada, 2005 to 2021



Data for Figure 1

Note: Except for the annual standards for nitrogen dioxide and sulphur dioxide, the 2020 Canadian Ambient Air Quality Standards use 3-year average concentrations. For this reason, the bar chart portrays percentage values over 3-year periods. The annual standards for nitrogen dioxide and sulphur dioxide use a single annual concentration for the 3-year reporting period. For example, for the 2019 to 2021 reporting

[1] Health effects can occur at levels below the 2020 CAAQS, so the Air Quality Management System includes the Air Zone Management Framework. It includes 4 colour-coded management levels which are associated with a suite of monitoring, reporting and management actions that become progressively more rigorous as air pollutant concentrations approach or exceed the CAAQS.

[2] The indicator uses the 2020 Canadian Ambient Air Quality Standards for comparative purposes only. Provinces and territories are responsible for reporting on achievement of the Canadian Ambient Air Quality Standards. For information on the Canadian Ambient Air Quality Standards, refer to the Canadian Council of Ministers of the Environment website.

[3] Results may fluctuate significantly from year-to-year due to extreme events such as wildfires.

period, the annual concentrations for 2021 were used for the annual standards for nitrogen dioxide and sulphur dioxide.
Source: Environment and Climate Change Canada (2023) Air Quality Research Division. Health Canada (2023) Air Health Effects Assessment Division.

The indicator uses a total of 7 standards[4] related to 4 air pollutants (fine particulate matter [$PM_{2.5}$], ground-level ozone [O_3], nitrogen dioxide [NO_2] and sulphur dioxide [SO_2]). All 7 of these standards must be met for the population of a given area to be counted as within (less than or equal to) the standards.

During the 2019 to 2021 reporting period, Ontario and British Columbia recorded the highest number of standard exceedances, with 14 and 17, respectively. Newfoundland and Labrador, Prince Edward Island, Nova Scotia, Manitoba, the Northwest Territories, Yukon, and Nunavut had no exceedances. These results may be influenced by the number and placement of monitoring stations. For detailed information on geographical areas where exceedances were observed, please refer to Annex B.

Over that period, exceedances of the 8-hour O_3 standard affected the largest proportion of the Canadian population, at 13.8%. Of the 14 communities showing exceedances of the O_3 standard, 13 communities are in southern Ontario where air quality is influenced by the flow of air pollutants from the United States.

Long term results by pollutant

- O_3 (8-hour): Between the 2005 to 2007 and 2019 to 2021 reporting periods, this was the most frequently exceeded standard. The proportion of the population living in areas where CAAQS exceedances occurred decreased significantly from 33.5% for the 2005 to 2007 reference period, to 13.8% for the 2019 to 2021 period.[5]
- $PM_{2.5}$ (annual): From the 2005 to 2007 to the 2012 to 2014 reporting periods, the proportion of the population living in areas exceeding the annual standard for $PM_{2.5}$ increased steadily from 3.9% to 15.8%. A decrease was then observed down to a proportion of 0.8% for the 2019 to 2021 reporting period. This improvement can be attributed to fewer large cities having exceedances over the latter reporting periods; for example, no exceedances were recently recorded in Montreal, Calgary, or Hamilton.
- $PM_{2.5}$ (24-hour): Between the 2005 to 2007 and 2015 to 2017 reporting periods, there has a been an overall decline in exceedances of the 24-hour standard for $PM_{2.5}$. The high proportion of population affected by exceedances in the reporting periods from 2016 to 2018 (12.2%), 2017 to 2019 (11.4%), and 2018 to 2020 (19.7%) can be attributed to the influence of smoke from large wildfires in the western United States and in British Columbia which greatly affected air quality in large communities in Alberta and British Columbia. In the most recent reporting period (2019 to 2021), this proportion fell from 19.7% to 1.0%.
- NO_2 (1-hour and annual): Between the 2005 to 2007 and 2019 to 2021 reporting periods, the proportion of the population living in areas exceeding one of the standards for NO_2 decreased from around 12% to 0.0%. Since the 2013 to 2015 reporting period, there has been only 1 exceedance of the 1-hour standard based on the methodology used in the indicator. This exceedance was in Brandon (Manitoba), which reported an exceedance of the 1-hour standard during the 2018 to 2020 period, affecting 0.14% of the Canadian population.
- SO_2 (1-hour and annual): Exceedances of the standards for SO_2 had minimal influence on the indicator. For the 2019 to 2021 reporting period, exceedance of one of the standards were recorded at 2 monitoring stations in Quebec, 1 station in Ontario, 1 station in Saskatchewan and 1 station in New Brunswick, totalling 0.45% of the Canadian population. These exceedances tend to be limited to areas near SO_2 sources. Despite its low influence on the indicator, SO_2 (specifically the 1-hour standard) remains a concern because of its health impacts on populations and the environment close to sulphur-emitting facilities.

[4] The indicator uses the following 2020 Canadian Ambient Air Quality Standards: a 24-hour standard and an annual standard for fine particulate matter, an 8-hour standard for ground-level ozone, a 1-hour standard and an annual standard for nitrogen dioxide and a 1-hour standard and an annual standard for sulphur dioxide.

[5] Ground-level O_3 is not emitted directly into the air. It is a pollutant that forms in the air through chemical reactions mainly between nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight.

About the indicator

What the indicator measures

This indicator tracks the percentage of the population living in Canadian regions where concentrations of outdoor air pollutants from all sources were less than or equal to the 2020 CAAQS. The indicator uses the following 2020 standards (see Table 1 for more details).

- fine particulate matter ($PM_{2.5}$): 24-hour and annual
- ground-level ozone (O_3): 8-hour
- nitrogen dioxide (NO_2): 1-hour and annual
- sulphur dioxide (SO_2): 1-hour and annual

Why this indicator is important

Canadians are exposed to air pollutants on a daily basis, and this exposure can result in adverse health effects. Exposure to some air pollutants, even at low levels, has been linked to increased heart and respiratory problems, leading to increased hospitalization, emergency room visits and premature death. The Government of Canada estimates that each year 42 premature deaths per 100 000 Canadians can be linked to air pollution for a total of 15 300 premature deaths per year. The total economic valuation of the health impacts attributable to air pollution in Canada is $120 billion per year (based on 2016 currency).[6]

Ground-level O_3 and $PM_{2.5}$ are key components of smog and two of the most widespread air pollutants. Exposure to O_3 and $PM_{2.5}$ can cause adverse health effects even at low levels. Exposure to O_3 can cause throat irritation, coughing, shortness of breath and aggravation of existing conditions such as asthma. Over time, exposure to O_3 may lead to development of asthma, reduced lung function and other lung conditions. Exposure to $PM_{2.5}$ can lead to onset or development of respiratory and cardiovascular adverse effects, such as asthma attacks, chronic bronchitis, heart attacks and may lead to the development of lung cancer.

Exposure to SO_2 and NO_2 can irritate the lungs, reduce lung function, and aggravate respiratory conditions especially in people with asthma. Long-term exposure to NO_2 may lead to the development of allergies and asthma. $PM_{2.5}$, O_3 and NO_2 are all known to cause adverse health effects at low concentrations.

Most CAAQS pollutants ($PM_{2.5}$, O_3, and NO_2) are considered to be non-threshold pollutants. This means that adverse health effects occur even at low concentrations.[6] A larger proportion of the Canadian population meeting the CAAQS is generally associated with lower overall levels of pollution exposure. Nevertheless, this proportion of the population is not considered to be "safe" from the adverse impacts of air pollution, but only at reduced health risk compared to populations exposed to higher concentrations of air pollution.

Besides their direct effects on human health, these pollutants also have adverse environmental impacts. NO_2 contributes to the formation of O_3 and $PM_{2.5}$ and has major impacts on acid deposition ("acid rain") and eutrophication (excessive nutrients in a body of water leading to algal blooms and low oxygen that impact the aquatic system). Similarly, SO_2 is also a major contributor to acid deposition and contributes to formation of $PM_{2.5}$. $PM_{2.5}$ can damage vegetation and structures and contributes to haze and reduced visibility. Ozone can also impact vegetation, decrease the productivity of some crops, and may contribute to forest decline. It can also damage synthetic materials and textiles, cause cracks in rubber, accelerate fading of dyes and speed deterioration of some paints and coatings.

Improved air quality reduces heart attacks, hospital visits, allergy, and child asthma attacks, and prevents lost school and workdays. Cleaner air can also reduce damage to crops, forests, surface waters and infrastructure such as buildings and bridges.[7]

Consult the Air pollution: drivers and impacts web page for information on the impacts of air pollution on human health, the economy and the environment.

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[6] Health Canada (2021) Health Impacts of Air Pollution in Canada: Estimates of morbidity and premature mortality outcomes – 2021 Report. Retrieved on September 22, 2023.

[7] Canadian Council of Ministers of the Environment (2021) State of the Air. Retrieved on September 22, 2023.

Related initiatives

This indicator tracks progress on the 2022 to 2026 Federal Sustainable Development Strategy, supporting the target: Increase the percentage of the population across Canada living in areas where air pollutant concentrations are less than or equal to the Canadian Ambient Air Quality Standards from 60%[8] in 2005 to 85% in 2030. The most recent data available shows that, between the 2005 to 2007 and the 2019 to 2021 reporting periods, the percentage of Canadians living in areas where outdoor concentrations of air pollutants were less than or equal to the 2020 Canadian Ambient Air Quality Standards increased from 63% to 85%.

In addition, the indicator contributes to the Sustainable Development Goals of the 2030 Agenda for Sustainable Development. It is linked to Goal 11, Sustainable Cities and Communities and Target 11.6, "By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management."

Related indicators

The Air health trends indicator provides an overview of the public health impacts attributable to outdoor air pollution in Canada.

The Air quality indicators track ambient concentrations of $PM_{2.5}$, O_3, SO_2, NO_2 and VOCs at the national and regional level and at local monitoring stations.

The Human exposure to harmful substances indicators track the concentrations of 4 substances (mercury, lead, cadmium and bisphenol A) in Canadians.

The Air pollutant emissions indicators track emissions from human activities of 6 key air pollutants: sulphur oxides (SO_X), nitrogen oxides (NO_X), volatile organic compounds (VOC), ammonia (NH_3), carbon monoxide (CO) and fine particulate matter ($PM_{2.5}$). Black carbon, which is a component of $PM_{2.5}$, is also reported. For each air pollutant, data are provided at the national, provincial/territorial and facility level and by major sources.

Data sources and methods

Data sources

The indicator is calculated from air pollutant concentration data and population statistics.

The air pollutant concentration data are taken from Environment and Climate Change Canada's Canada-wide Air Quality Database. The population data were retrieved from Statistics Canada's demographic statistics.

More information

Air pollution concentration data

The Canada-wide Air Quality Database contains data collected through the National Air Pollution Surveillance Program which is a collaboration between Environment and Climate Change Canada, provincial, territorial and regional government networks.

Population data

The 2005, 2007 to 2010 population estimates were received from Statistics Canada. These estimates are based on the 2011 Standard Geographical Classification. The following datasets were timestamped, May 26, 2014.

- Table 1 Annual population estimates by sex, July 1 2005, Census Subdivisions, Canada
- Table 1 Annual population estimates by sex, July 1 2007, Census Subdivisions, Canada
- Table 1 Annual population estimates by sex, July 1 2008, Census Subdivisions, Canada
- Table 1 Annual population estimates by sex, July 1 2009, Census Subdivisions, Canada
- Table 1 Annual population estimates by sex, July 1 2010, Census Subdivisions, Canada

[8] The 2005 baseline of 60% presented in the 2022 to 2026 Federal Sustainable Development Strategy is informed by the estimated value for the 2005 to 2007 reporting period from the indicator released in 2021.

The 2006 Census of population data were from the Statistics Canada Census Datasets website. The dataset was timestamped, May 29, 2008.

The 2011 Census of population data were from the Statistics Canada Census Datasets website. The dataset was timestamped, August 21, 2014.

The 2012 to 2015 population estimates were received from Statistics Canada. These estimates are based on the 2011 Standard Geographical Classification. The following datasets were timestamped, March 10, 2016.

- Table 1 Annual population estimates by sex, July 1 2012, Census Subdivisions, Canada
- Table 1 Annual population estimates by sex, July 1 2013, Census Subdivisions, Canada
- Table 1 Annual population estimates by sex, July 1 2014, Census Subdivisions, Canada
- Table 1 Annual population estimates by sex, July 1 2015, Census Subdivisions, Canada

The 2016 Census of population data were from the Statistics Canada Census Datasets website. The dataset was timestamped, August 28, 2017.

The 2017 to 2021 population estimates were received from Statistics Canada. These estimates are based on the 2016 Standard Geographical Classification. The following datasets were timestamped, September 28, 2022.

- Table 1 Annual population estimates by sex, July 1 2017, Census Subdivisions, Canada
- Table 1 Annual population estimates by sex, July 1 2018, Census Subdivisions, Canada
- Table 1 Annual population estimates by sex, July 1 2019, Census Subdivisions, Canada
- Table 1 Annual population estimates by sex, July 1 2020, Census Subdivisions, Canada
- Table 1 Annual population estimates by sex, July 1 2021, Census Subdivisions, Canada

Canadian Ambient Air Quality Standards

In October 2012, the ministers of the Environment of all provinces and territories, except Quebec,[9] agreed to begin implementing the Air Quality Management System. This system provides a comprehensive, cross-Canada framework for collaborative action to further protect human health and the environment through continuous improvement of air quality. Under the system, the Canadian Ambient Air Quality Standards (CAAQS, the standards) are drivers for air quality improvement across the country. The CAAQS are health and environmental-based air quality objectives for pollutant concentrations in outdoor air. Together with the management levels,[10] the CAAQS act as a benchmark to support continuous improvement of air quality. The standards are not "pollute-up-to levels" and the Air Quality Management System encourages governments to take action to improve air quality, considering that some pollutants can affect human health even at concentrations below the standards.

Under the *Canadian Environmental Protection Act, 1999*, the 2020 CAAQS were established:

- for fine particulate matter and ozone in May 2013
- for sulphur dioxide in October 2017
- for nitrogen dioxide in December 2017

The 2020 CAAQS replaced the 2015 CAAQS for fine particulate matter and ozone. More stringent CAAQS for ozone, nitrogen dioxide and sulphur dioxide have been established for 2025. For consistency, the indicator uses the 2020 CAAQS numerical values. For more information on the 2015 and 2025 numerical values, refer to the Canadian Ambient Air Quality Standards.

[9] Although Quebec supports the general objectives of the Air Quality Management System, it will not implement the system since it includes federal industrial emission requirements that duplicate Quebec's regulations. However, Quebec is collaborating with jurisdictions on developing other elements of the system, notably air zones and airsheds.

[10] Management levels refer to the air zone management framework. More information can be found in the Canadian Council of Ministers of the Environment's Guidance document on air zone management (PDF; 225 kB).

Table 1. Canadian Ambient Air Quality Standards for 2020

Pollutant	Averaging time	2020 Standard (numerical value)	Statistical form
Fine particulate matter	24-hour (calendar day)	27 µg/m^3	The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations
Fine particulate matter	Annual (calendar year)	8.8 µg/m^3	The 3-year average of the annual average of the daily 24-hour average concentrations
Ozone	8-hour	62 ppb	The 3-year average of the annual 4th-highest of the daily maximum 8-hour average concentrations
Nitrogen dioxide	1-hour	60 ppb	The 3-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations
Nitrogen dioxide	Annual (calendar year)	17.0 ppb	The arithmetic average over a single calendar year of all 1-hour average concentrations
Sulphur dioxide	1-hour	70 ppb	The 3-year average of the annual 99th percentile of the daily maximum 1-hour average concentrations
Sulphur dioxide	Annual (calendar year)	5.0 ppb	The arithmetic average over a single calendar year of all 1-hour average concentrations

Note: Units: µg/m^3 = micrograms per cubic metre, ppb = parts per billion.

Methods

The indicator is calculated by comparing the spatially averaged pollutant concentration for each geographical area with the respective 2020 Canadian Ambient Air Quality Standards (CAAQS, the standards). The total population of all geographical areas where the average concentrations for all pollutants are less than or equal to the respective standards are compared to the national population.

More information

Data completeness criteria

Concentration values at monitoring stations are considered to be "valid" and are used in the calculation of the indicator if they meet the related data completeness criteria specified in Table 2.

Table 2. Monitoring station data completeness criteria used in the calculation of the indicator

Pollutant	Averaging time	Data completeness and calculation criteria
Fine particulate matter	24-hour (calendar day)	• A daily 24-hour average concentration was considered valid if at least 75% (18 hours) of the 1-hour concentrations were available on a given day • A 98th percentile of the daily average concentration was considered valid if at least 75% of the daily average concentrations were available for the year and at least 60% of the daily average concentrations were available in each quarter[A] of a calendar year • For the 3-year average, at least 2 of the 3 years were needed
Fine particulate matter	Annual (calendar year)	• A daily 24-hour average concentration was considered valid if at least 75% (18 hours) of the 1-hour concentrations were available on a given day • An annual average concentration was considered valid if at least 75% of the daily average concentrations were available for the year and at least 60% of the daily average concentrations were available in each quarter[A] of a calendar year • For the 3-year average, at least 2 of the 3 years were needed

Pollutant	Averaging time	Data completeness and calculation criteria
Ozone	8-hour	• Rolling (or moving) 8-hour average concentrations were calculated for each hour of the day from the 1-hour average concentrations, resulting in up to 24 8-hour average concentrations per day • To be valid a rolling 8-hour average concentration must have at least 6 1-hour average concentrations • A daily maximum 8-hour average concentration was considered valid if at least 75% (18) of the 8-hour rolling average concentrations were available in the day • The annual 4th-highest daily maximum 8-hour average concentration was considered valid if there were at least 75% of all daily maximum 8-hour average concentrations were available for the year and at least 60% in each quarter were available • For the 3-year average, at least 2 of the 3 years were needed
Nitrogen dioxide	1-hour	• The daily maximum 1-hour average concentration was considered valid if at least 75% (18) of the hourly concentrations were available on a given day • The 98th percentile of the daily maximum 1-hour average concentrations was considered valid if at least 75% of the daily maximum 1-hour average concentrations for the year were available and at least 60% in each quarter were available • For the 3-year average, at least 2 of the 3 years were needed
Nitrogen dioxide	Annual (calendar year)	• An annual average concentration was considered valid if at least 75% of all the 1-hour average concentrations were available for the year and at least 60% were available in each quarter
Sulphur dioxide	1-hour	• The daily maximum 1-hour average concentration was considered valid if at least 75% (18 hours) of the hourly concentrations were available on a given day • The annual 99th percentile of the daily maximum 1-hour average concentrations was considered valid if at least 75% of all the daily maximum 1-hour average concentrations for the year were available and at least 60% in each quarter were available • For the 3-year average, at least 2 of the 3 years were needed
Sulphur dioxide	Annual (calendar year)	• An annual average concentration was considered valid if at least 75% of all the 1-hour average concentrations were available for the year and at least 60% were available in each quarter

Note: [A] The calendar quarters are as follows: quarter 1 from January 1 to March 31; quarter 2 from April 1 to June 30; quarter 3 from July 1 to September 30 and quarter 4 from October 1 to December 31.

For a geographical area having only 1 monitoring station, the data completeness criteria of Table 2 are applied. For a geographical area having more than 1 monitoring station, the data completeness criteria of Table 2 are applied to the overall data available for all monitoring stations within the geographical area. In such a case, the averaged concentration of all monitoring stations is reported for that particular geographical area even though each of the monitoring stations could have incomplete data.

Geographical areas

Each air quality monitoring station is assigned to a geographical area. Only stations that are selected by provinces and territories for reporting on CAAQS achievement under the Air Quality Management System are used in the calculation.

For fine particulate matter, ground-level ozone and nitrogen dioxide, these areas are either a Statistics Canada's census metropolitan area, census division or census subdivision. For each year from 2005 to 2021, population counts are allocated to each geographical area with at least 1 monitoring station.

Because high sulphur dioxide concentrations tend to be localized around point sources, the geographical area for the annual and 1-hour standard for sulphur dioxide was set to a 2-kilometre (km) radius around

the station. Only population data within the 2 km boundary of the monitoring station were used. In this case, Statistics Canada's dissemination block data were used to calculate the population within the 2 km boundary of a station.

Refer to Annex B for a list of geographic areas used to calculate the indicator.

Air pollutant concentrations by geographical area

For each air pollutant and averaging time, the following steps were used to assign a concentration value to each geographical area.

1. A concentration value was first calculated for each monitoring station in the area using the data completeness and calculation criteria outlined in Table 2
2. The arithmetic average was calculated from the concentration values of all monitoring stations in the geographical area.

For example, Winnipeg has 2 monitoring stations that meet the data completeness criteria for fine particulate matter. The annual average concentration of fine particulate matter for Winnipeg is calculated by using the following steps.

1. The daily 24-hour average concentration for each monitoring station was calculated.
    - if at least 75% (18 hours) of the 1-hour concentrations for the station were available on a given day (from Table 2)
2. An average daily 24-hour concentration using all monitoring stations within Winnipeg was calculated.
3. An annual average concentration for Winnipeg was then calculated.
    - if at least 75% of the daily average concentrations were available for the year and at least 60% of the daily average concentrations were available in each quarter of a calendar year (from Table 2)

Comparison with the standards and total population below the standards

The concentration value for each pollutant was then compared to the respective standard to determine if the population in the geographical area was exposed to pollutant levels less than or equal to the corresponding standard. This comparison was done for each pollutant and for each standard.

- If the concentration value for the area was less than or equal to the respective standard for all 7 CAAQS, the population count was recorded for the geographical area.
- If at least 1 standard was exceeded, the population for the geographical area was set to 0.

The population from all geographical areas with average concentrations less than or equal to all CAAQS were then added together. The sum was then divided by the total Canadian population and multiplied by 100 to produce the percentage of the population that lives in an area where air pollutant concentrations were less than or equal to the standards. The general formula is as follows:

100 * (sum of the population at or below all CAAQS ÷ total population of Canada)

where the population at or below all CAAQS = the population of Canadians living in geographical areas where ambient concentrations of fine particulate matter, ozone, nitrogen dioxide and sulphur dioxide are all less than or equal to their respective standard.

Caveats and limitations

From 2005 to 2021, approximately 63.5% of the population lived in areas covered by selected air quality monitoring stations that meet the data completeness criteria. Refer to Annex B for a list of geographical areas used in the indicator. The indicator assumes that the remainder of the population lives in areas where outdoor

concentrations of ozone, fine particulate matter, sulphur dioxide and nitrogen dioxide are less than or equal to their 2020 standards.[11]

Populations in northern regions of the country have less coverage, as monitoring stations tend to be situated near urban areas with high population density.

Due to unpredictable variability in extreme weather events such as wildfires, results may fluctuate significantly from one reporting period to another.

More information

This indicator is used to report the percentage of the Canadian population living in areas where outdoor concentrations of air pollutants were less than (or equal to) the 2020 Canadian Ambient Air Quality Standards (CAAQS, the standards). The indicator is not used for formally reporting the achievement status of the standards. Under the Air Quality Management System, reporting on achievement of the standards is a provincial and territorial responsibility.

The method used to calculate the indicator differs from that used to report on the achievement status of the CAAQS. In particular, for the indicator, the average concentration from CAAQS monitoring stations in the geographical area is used to compare against the standard. However, for the purpose of reporting on CAAQS achievement, the determination is made on a per-station basis and all stations in a given geographical area (i.e. air zone) have to meet the standard to be considered as achieved. In addition, provinces and territories can remove days impacted by transboundary flow and exceptional events to assign their management levels. As a result, this indicator may consider average concentrations that are higher than reported by provinces and territories.

Populations not covered by monitoring stations were assumed to be below the standards. While this results in some uncertainty regarding the estimated population below the standards, a sensitivity analysis indicated that this assumption does not result in a large error. Ongoing research and analysis are being conducted on methods that will consider the entire population.

Some data collected at monitoring stations cannot be used in calculating the indicator because the data do not meet the data completeness criteria. The removal of this data can influence the number of geographical areas used per reporting period. Refer to Annex B for a list of geographical areas used in the indicator.

The indicator uses the actual concentrations measured at monitoring stations. Some of these concentrations may have been influenced by pollutant sources in other countries and by smoke from wildfires both within and outside Canada.

Resources

References

National Forestry Database (2023) Forest area burned and number of forest fires. Retrieved on September 22, 2023.

Canadian Council of Ministers of the Environment (2012) Guidance document on achievement determination for Canadian Ambient Air Quality Standards for fine particulate matter and ozone (PDF; 264 kB). Retrieved on September 22, 2023.

Canadian Council of Ministers of the Environment (2014) Air Quality Management System. Retrieved on September 22, 2023.

Canadian Council of Ministers of the Environment (2017) State of the air. Retrieved on September 22, 2023.

[11] While this assumption holds for most of the pollutants used in the analysis of the indicator, ground-level ozone concentrations are generally higher outside urban cores. For example, a region such as Southwestern Ontario, it is likely that the entire region would be above the Canadian Ambient Air Quality Standard for ozone.

Canadian Council of Ministers of the Environment (2019) Guidance document on air zone management (PDF; 225 kB). Retrieved on September 22, 2023.

Canadian Council of Ministers of the Environment (2020) Guidance document on achievement determination for Canadian Ambient Air Quality Standards for nitrogen dioxide (PDF; 616 kB). Retrieved on September 22, 2023.

Canadian Council of Ministers of the Environment (2020) Guidance document on achievement determination for Canadian Ambient Air Quality Standards for sulphur dioxide (PDF; 586 kB). Retrieved on September 22, 2023.

Environment and Climate Change Canada (2020) National Air Pollution Surveillance Program. Retrieved on September 22, 2023.

Government of Canada (2023) Outdoor air pollution and health. Retrieved on September 22, 2023.

Related information

Air pollution: drivers and impacts

Canadian Smog Science Assessment Highlights and Key Messages

Smog: causes and effects

Annexes

Annex A. Data table for the figure presented in this document

Table A.1. Data for Figure 1. Percentage of Canadians living in areas where outdoor concentrations of air pollutants were at or below the 2020 Canadian Ambient Air Quality Standards, Canada, 2005 to

Period	Proportion of the population where air pollutants were at or below the standards (percentage)
2005 to 2007	63
2006 to 2008	65
2007 to 2009	66
2008 to 2010	69
2009 to 2011	67
2010 to 2012	66
2011 to 2013	66
2012 to 2014	66
2013 to 2015	70
2014 to 2016	79
2015 to 2017	78
2016 to 2018	68
2017 to 2019	71
2018 to 2020	64
2019 to 2021	85

Note: Except for the annual standard for nitrogen dioxide and sulphur dioxide, the 2020 Canadian Ambient Air Quality Standards used in the indicator use 3-year average concentrations. For this reason, the table portrays percentage values over 3-year periods. The annual standards for nitrogen dioxide and sulphur dioxide use a single annual concentration for the 3-year reporting period. For example, for the 2019 to 2021 reporting period, the annual concentrations for 2021 were used for the annual standards for nitrogen dioxide and sulphur dioxide.
Source: Environment and Climate Change Canada (2023) Air Quality Research Division. Health Canada (2023) Air Health Effects Assessment Division.

Annex B. Geographical areas used to calculate the indicator

Table B.1. Geographical areas used to calculate the indicator

Census subdivision, census metropolitan area or census division	Province or territory	Community	Reporting periods used
1	Newfoundland and Labrador	St. John's	2005-2007 to 2019-2021
1002002	Newfoundland and Labrador	Lewin's Cove	2014-2016 to 2019-2021
1002005	Newfoundland and Labrador	Burin	2014-2016 to 2019-2021
1005018	Newfoundland and Labrador	Corner Brook	2005-2007 to 2019-2021
1006017	Newfoundland and Labrador	Grand Falls-Windsor	2005-2007 to 2019-2021
1009022	Newfoundland and Labrador	Port au Choix	2014-2016 to 2019-2021
1010032	Newfoundland and Labrador	Labrador City	2014-2016 to 2019-2021
1102075	Prince Edward Island	Charlottetown	2014-2016 to 2019-2021
1207001	Nova Scotia	Kings, Subd. A	2005-2007 to 2019-2021
1207012	Nova Scotia	Kentville	2018-2020 to 2019-2021
1209034	Nova Scotia	Halifax	2005-2007 to 2019-2021
1212004	Nova Scotia	Pictou	2005-2007 to 2019-2021
1215002	Nova Scotia	Port Hawkesbury	2005-2007 to 2019-2021
1217030	Nova Scotia	Cape Breton	2005-2007 to 2019-2021
1301006, 310	New Brunswick	Saint John	2005-2007 to 2019-2021
1302026	New Brunswick	Saint Andrews	2005-2007 to 2019-2021
1307022	New Brunswick	Moncton	2005-2007 to 2019-2021
1310032	New Brunswick	Fredericton	2005-2007 to 2019-2021
1313027	New Brunswick	Edmunston	2016-2018 to 2019-2021
1315011	New Brunswick	Bathurst	2005-2007 to 2019-2021
2413045	Quebec	Auclair	2005-2007 to 2019-2021
2418040	Quebec	Notre-Dame-du-Rosaire	2018-2020 to 2019-2021
2420005	Quebec	Saint-Francois-de-l'Île-d'Orléans	2005-2007 to 2016-2018, 2018-2020
2423027, 2423	Quebec	Québec	2005-2007 to 2019-2021
2425213	Quebec	Levis	2014-2016 to 2019-2021
2429020	Quebec	Saint-Hilaire-de-Dorset	2005-2007 to 2019-2021
2434058	Quebec	Deschambault-Grondines	2005-2007 to 2019-2021
2437067	Quebec	Trois-Rivières	2005-2007 to 2019-2021
2439025	Quebec	Tingwick	2005-2007 to 2019-2021
2441027	Quebec	La Patrie	2005-2007 to 2019-2021
2443027	Quebec	Sherbrooke	2005-2007 to 2019-2021
2450090	Quebec	Saint-Zéphirin-de-Courval	2005-2007 to 2019-2021
2451080	Quebec	Charette	2005-2007 to 2019-2021

Census subdivision, census metropolitan area or census division	Province or territory	Community	Reporting periods used
2454090	Quebec	Saint-Simon	2005-2007 to 2019-2021
2456083	Quebec	Saint-Jean-sur-Richelieu	2005-2007 to 2019-2021
2458007	Quebec	Brossard	2005-2007 to 2019-2021
2458227	Quebec	Longueuil	2005-2007 to 2019-2021
2464008	Quebec	Terrebonne	2015-2017 to 2019-2021
2465005	Quebec	Laval	2005-2007 to 2019-2021
2466023, 2466	Quebec	Montréal	2005-2007 to 2019-2021
2469070	Quebec	Saint-Anicet	2005-2007 to 2019-2021
2478047	Quebec	Saint-Faustin–Lac-Carré	2005-2007 to 2019-2021
2479097	Quebec	Ferme-Neuve	2005-2007 to 2019-2021
2481017	Quebec	Gatineau	2005-2007 to 2019-2021
2482035	Quebec	La Pêche	2005-2007 to 2019-2021
2486042	Quebec	Rouyn-Noranda	2005-2007 to 2019-2021
2489040	Quebec	Senneterre	2005-2007 to 2019-2021
2490027	Quebec	Lac-Édouard	2005-2007 to 2019-2021
2491050	Quebec	La Doré	2005-2007 to 2019-2021
2494068	Quebec	Saguenay	2005-2007 to 2019-2021
3506008	Ontario	Ottawa	2005-2007 to 2019-2021
3510010	Ontario	Kingston	2005-2007 to 2019-2021
3515014	Ontario	Peterborough	2005-2007 to 2019-2021
3518013	Ontario	Oshawa	2005-2007 to 2019-2021
3519028	Ontario	Vaughn	2016-2018 to 2019-2021
3519048	Ontario	Newmarket	2005-2007 to 2019-2021
3520005	Ontario	Toronto	2005-2007 to 2019-2021
3521005	Ontario	Mississauga	2005-2007 to 2019-2021
3521010	Ontario	Brampton	2005-2007 to 2019-2021
3523008	Ontario	Guelph	2005-2007 to 2019-2021
3524001	Ontario	Oakville	2005-2007 to 2019-2021
3524002	Ontario	Burlington	2005-2007 to 2019-2021
3524009	Ontario	Milton	2018-2020 to 2019-2021
3525005	Ontario	Hamilton	2005-2007 to 2019-2021
3526053	Ontario	St. Catharines	2005-2007 to 2019-2021
3529006	Ontario	Brantford	2005-2007 to 2019-2021
3530013	Ontario	Kitchener	2005-2007 to 2019-2021
3534020	Ontario	Central Elgin	2005-2007 to 2019-2021
3537039	Ontario	Windsor	2005-2007 to 2019-2021

Census subdivision, census metropolitan area or census division	Province or territory	Community	Reporting periods used
3538030	Ontario	Sarnia	2005-2007 to 2019-2021
3538031	Ontario	Point Edward	2014-2016 to 2019-2021
3539036	Ontario	London	2005-2007 to 2019-2021
3543042	Ontario	Barrie	2005-2007 to 2019-2021
3553005	Ontario	Greater Sudbury	2005-2007 to 2019-2021
3557061	Ontario	Sault Ste. Marie	2005-2007 to 2019-2021
3558004	Ontario	Thunder Bay	2005-2007 to 2019-2021
4607062	Manitoba	Brandon	2005-2007 to 2019-2021
4621064	Manitoba	Flin Flon (Part)	2014-2016, 2016-2018 to 2018-2020
4622026	Manitoba	Thompson	2014-2016 to 2018-2020
4611040, 602	Manitoba	Winnipeg	2005-2007 to 2019-2021
4701024	Saskatchewan	Estevan	2016-2018 to 2019-2021
4706027	Saskatchewan	Regina	2005-2007 to 2019-2021
4708004	Saskatchewan	Swift Current	2014-2016 to 2019-2021
4711066	Saskatchewan	Saskatoon	2005-2007 to 2019-2021
4715066	Saskatchewan	Prince Albert	2005-2007 to 2019-2021
4801006	Alberta	Medicine Hat	2005-2007 to 2019-2021
4802012	Alberta	Lethbridge	2005-2007 to 2019-2021
825	Alberta	Calgary	2005-2007 to 2019-2021
4808011	Alberta	Red Deer	2005-2007 to 2019-2021
4809002	Alberta	Clearwater County	2018-2020 to 2019-2021
4810058	Alberta	Lamont County	2005-2007 to 2019-2021
4811031	Alberta	Drayton Valley	2014-2016 to 2019-2021
4811032	Alberta	Brazeau County	2014-2016 to 2019-2021
4811061, 835	Alberta	Edmonton	2005-2007 to 2019-2021
4812002	Alberta	Cold Lake	2005-2007 to 2019-2021
4812014	Alberta	St. Paul County No. 19	2005-2007 to 2019-2021
4813001	Alberta	Lac Ste. Anne County	2014-2016 to 2019-2021
4814003	Alberta	Yellowhead County	2005-2007 to 2019-2021
4814019	Alberta	Hinton	2005-2007 to 2019-2021
4814024	Alberta	Edson	2005-2007 to 2019-2021
860	Alberta	Wood Buffalo	2005-2007 to 2019-2021
4819006	Alberta	Grande Prairie County No. 1	2005-2007 to 2019-2021
4819009	Alberta	Beaverlodge	2014-2016 to 2019-2021
4819012	Alberta	Grande Prairie	2005-2007 to 2019-2021

Census subdivision, census metropolitan area or census division	Province or territory	Community	Reporting periods used
5903045	British Columbia	Castlegar	2014-2016 to 2019-2021
5903058	British Columbia	Central Kootenay J	2014-2016 to 2019-2021
5905032	British Columbia	Grand Forks	2015-2017 to 2019-2021
5909009	British Columbia	Hope	2005-2007 to 2019-2021
5909020	British Columbia	Chilliwack	2005-2007 to 2019-2021
932	British Columbia	Abbotsford	2005-2007 to 2019-2021
933	British Columbia	Vancouver	2005-2007 to 2019-2021
5909032	British Columbia	Kent	2014-2016 to 2019-2021
935	British Columbia	Victoria	2005-2007 to 2019-2021
5919008	British Columbia	North Cowichan	2014-2016 to 2019-2021
5919012	British Columbia	Duncan	2005-2007 to 2019-2021
5921007	British Columbia	Nanaimo	2005-2007 to 2019-2021
5923008	British Columbia	Port Alberni	2014-2016 to 2019-2021
5923037	British Columbia	Alberni-Clayoquot E	2014-2016
5923801	British Columbia	Ahahswinis 1	2014-2016
5924034	British Columbia	Campbell River	2005-2007 to 2019-2021
5926010	British Columbia	Courtenay	2005-2007 to 2019-2021
5927008	British Columbia	Powell River	2014-2016 to 2016-2018
5929028	British Columbia	Sunshine Coast F	2014-2016 to 2019-2021
5931006	British Columbia	Squamish	2005-2007 to 2019-2021
5931020	British Columbia	Whistler	2005-2007 to 2019-2021
5931807	British Columbia	Cheakamus 11	2014-2016 to 2019-2021
5933042	British Columbia	Kamloops	2005-2007 to 2019-2021
5933880	British Columbia	Kamloops 1	2014-2016 to 2015-2017, 2018-2020 to 2019-2021
5935010	British Columbia	Kelowna	2005-2007 to 2019-2021
5937014	British Columbia	Vernon	2005-2007 to 2019-2021
5939007	British Columbia	Golden	2014-2016 to 2019-2021
5941009	British Columbia	Williams Lake	2005-2007 to 2019-2021
5941013	British Columbia	Quesnel	2005-2007 to 2019-2021
5941021	British Columbia	Cariboo B	2014-2016 to 2018-2020
5949005	British Columbia	Kitimat	2014-2016 to 2019-2021
5949011	British Columbia	Terrace	2014-2016 to 2019-2021
5949803	British Columbia	Kitimat 2	2014-2016 to 2019-2021
5951007	British Columbia	Vanderhoof	2014-2016 to 2019-2021
5951022	British Columbia	Burns Lake	2014-2016 to 2019-2021

Census subdivision, census metropolitan area or census division	Province or territory	Community	Reporting periods used
5951034	British Columbia	Houston	2014-2016 to 2019-2021
5951043	British Columbia	Smithers	2005-2007 to 2019-2021
5953023	British Columbia	Prince George	2005-2007 to 2019-2021
5955034	British Columbia	Fort St. John	2014-2016 to 2019-2021
6001009	Yukon	Whitehorse	2005-2007 to 2019-2021
6101017	Northwest Territories	Inuvik	2005-2007 to 2019-2021
6102007	Northwest Territories	Norman Wells	2005-2007 to 2019-2021
6105001	Northwest Territories	Fort Smith	2014-2016 to 2019-2021
6106023	Northwest Territories	Yellowknife	2005-2007 to 2019-2021
6204003	Nunavut	Iqaluit	2015-2017 to 2018-2020

Table B.2 Geographical areas with exceedances from the standards for the 2019-2021 reporting period

Province or territory	Community	Standard exceeded
New Brunswick	Edmunston	1-hour standard for SO_2
Quebec	Rouyn-Noranda	1-hour standard for SO_2
Quebec	Saguenay	1-hour standard for SO_2
Ontario	Brampton	8-hour standard for O_3
Ontario	Brantford	8-hour standard for O_3
Ontario	Burlington	8-hour standard for O_3
Ontario	Central Elgin	8-hour standard for O_3
Ontario	Hamilton	1-hour standard for SO_2
Ontario	Kingston	8-hour standard for O_3
Ontario	Milton	8-hour standard for O_3
Ontario	Newmarket	8-hour standard for O_3
Ontario	Oakville	8-hour standard for O_3
Ontario	Oshawa	8-hour standard for O_3
Ontario	Sarnia	8-hour standard for O_3
Ontario	St. Catharines	8-hour standard for O_3
Ontario	Toronto	8-hour standard for O_3
Ontario	Windsor	8-hour standard for O_3
Saskatchewan	Estevan	1-hour standard for SO_2
Saskatchewan	Prince Albert	24-hour standard for $PM_{2.5}$
Alberta	Medicine Hat	8-hour standard for O_3
British Columbia	Burns Lake	Annual standard for $PM_{2.5}$
		24-hour standard for $PM_{2.5}$
British Columbia	Castlegar	Annual standard for $PM_{2.5}$
		24-hour standard for $PM_{2.5}$
British Columbia	Golden	Annual standard for $PM_{2.5}$
		24-hour standard for $PM_{2.5}$
British Columbia	Grand Forks	Annual standard for $PM_{2.5}$
		24-hour standard for $PM_{2.5}$
British Columbia	Kamloops	Annual standard for $PM_{2.5}$
		24-hour standard for $PM_{2.5}$
British Columbia	Kelowna	Annual standard for $PM_{2.5}$
		24-hour standard for $PM_{2.5}$
British Columbia	Quesnel	24-hour standard for $PM_{2.5}$
British Columbia	Sunshine Coast F	24-hour standard for $PM_{2.5}$
British Columbia	Vanderhoof	24-hour standard for $PM_{2.5}$
British Columbia	Vernon	Annual standard for $PM_{2.5}$
		24-hour standard for $PM_{2.5}$

Additional information can be obtained at:

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