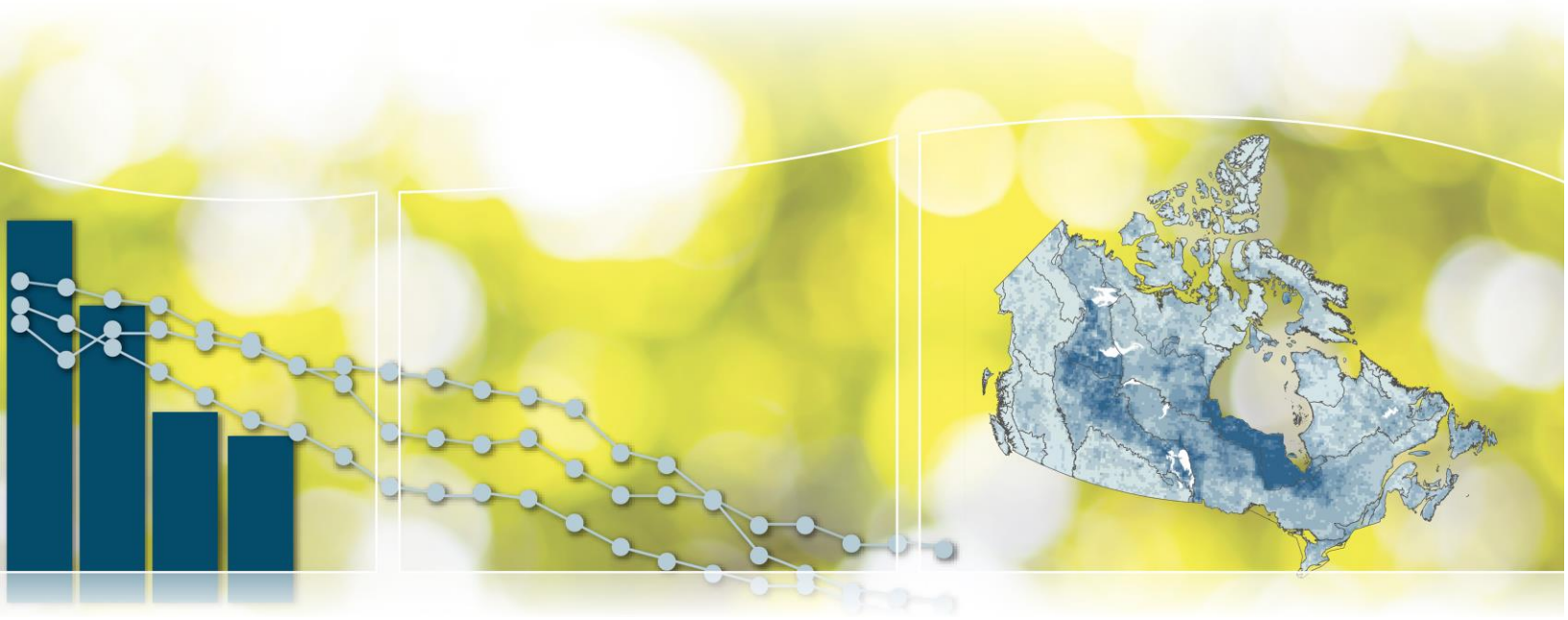
Environment and Climate Change Canada
Environnement et Changement climatique Canada

Canadian Environmental Sustainability Indicators

Emissions of harmful substances to air



Canada

Suggested citation for this document: Environment and Climate Change Canada (2018) Canadian Environmental Sustainability Indicators: Emission of harmful substances to air. Consulted on *Month day, year*.
Available at: www.canada.ca/en/environment-climate-change/services/environmental-indicators/emissions-harmful-substances-air.html.

Cat. No.: En4-144/82-2018E-PDF
ISBN: 978-0-660-27514-7

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Canadian Environmental Sustainability Indicators

Emission of harmful substances to air

August 2018

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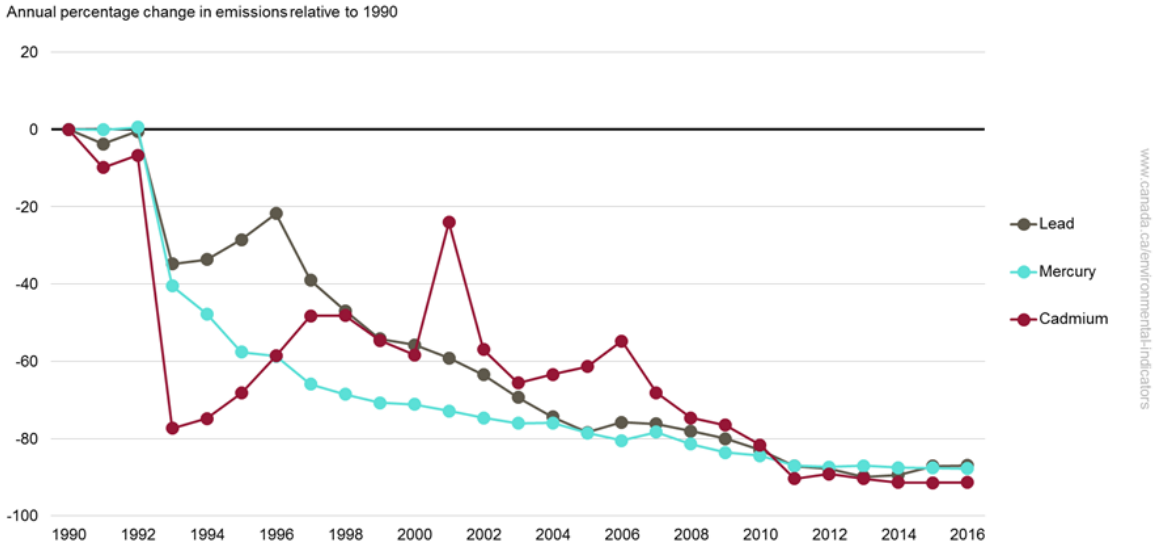
Emission of harmful substances to air

Emissions of some substances can harm human health, wildlife and biological diversity. For example, small particles of toxic metals can travel long distances in the air and be inhaled or settle on the ground and in water. There, they can enter the food web and build up in the tissues of living organisms. Exposure to these substances, even in small amounts, can be hazardous to both humans and wildlife. These indicators track human-related emissions of mercury, lead and cadmium.

Key results

- In 2016, mercury, lead and cadmium emissions were about 90% lower than in 1990
- The decrease in emissions came mostly from large reductions in the non-ferrous mining and smelting industry
- The decreases for mercury, lead and cadmium have plateaued since 2011

Figure 1. Mercury, lead and cadmium emissions to air, Canada, 1990 to 2016



Data for Figure 1

Note: This indicator reports emissions from human activities only.
Source: Environment and Climate Change Canada (2018) Air Pollutant Emission Inventory.

Lead, mercury and cadmium emissions decreased by 87%, 88% and 91%, respectively, between 1990 and 2016.

The decline in lead emissions resulted from implementing regulations that limited or eliminated lead in some products (such as gasoline and paints) and implementing measures in smelters, along with closing outdated smelters. Reductions in emissions from mining and rock quarrying from 1990 to 1998, as well as slight emission reductions in air transportation across the whole period, also influenced the overall decline in lead emissions since 1990.

Mercury emissions reductions are mostly attributed to the actions of a single large facility in Flin Flon, Manitoba over this period. This included changing its zinc production method, ceasing operation of an outdated copper process, improving its controls of particulate matter emissions and switching to cleaner fuels.

Cadmium emissions fluctuated between 1990 and 2006, but decreased steadily from 2006 to 2011. As with lead emissions, reductions in cadmium emissions are attributed to the closure of outdated

smelters and the implementation of pollution prevention plans. Fluctuations in cadmium emissions prior to 2010 are mostly driven by emissions from the facility in Flin Flon.

The decreases in emissions of lead, mercury and cadmium slowed or plateaued in recent years. This may be due to a range of competing factors such as changes in the level of production as well as the implementation of new technologies, facility closures and regulations coming into force in the earlier years.

Mercury and its compounds, lead, and inorganic cadmium compounds are listed as toxic[1] substances under the Canadian Environmental Protection Act, 1999.

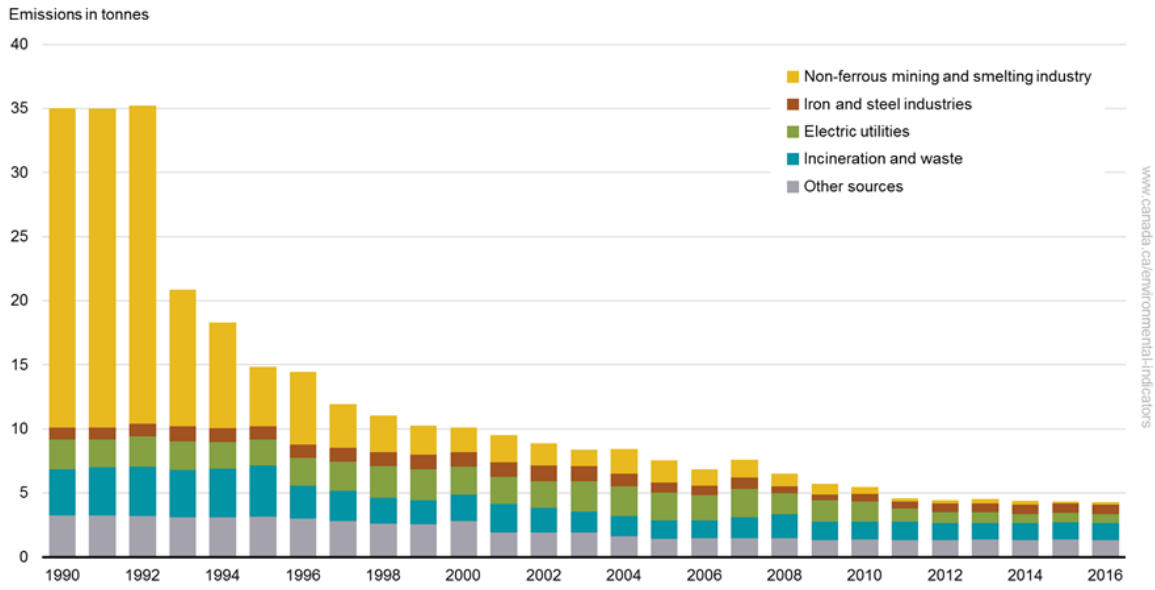
Emissions of mercury to air

Mercury is of global concern. It is carried long distances in the atmosphere and settles everywhere in Canada, including sensitive areas such as the Canadian Arctic and the Great Lakes. Mercury can be emitted to the air during forest fires, volcanic episodes and other geological activities.

Key results

- Between 1990 and 2016, mercury emissions decreased by 88% (or 30.7 tonnes)
    - after a 41% decrease between 1992 and 1993, emissions declined steadily until 2011
    - emissions have been stable since 2011
- In 2016, the largest source was incineration and waste, accounting for 31% of the total

Figure 2. Mercury emissions to air by source, Canada, 1990 to 2016



Data for Figure 2

Note: The indicator reports emissions from human activities only. The category "other sources" includes agriculture (livestock, crop production and fertilizer), building heating and energy generation, home firewood burning, manufacturing, the oil and gas industry, ore and mineral industries (except for the non-ferrous mining and smelting industry, and the iron and steel industries), transportation (road, rail, air and marine) and other miscellaneous sources. For more details on the sources, consult Table 1.
Source: Environment and Climate Change Canada (2018) Air Pollutant Emission Inventory.

[1] Section 64 of the Canadian Environmental Protection Act, 1999, defines a substance as toxic if it is "entering or may enter the environment in a quantity or concentration or under conditions that (a) have or may have an immediate or long-term harmful effect on the environment or its biological diversity; (b) constitute or may constitute a danger to the environment on which life depends; or (c) constitute or may constitute a danger in Canada to human life or health."

The largest reduction in mercury emissions between 1990 and 2016 was in the non-ferrous mining and smelting industry. This industry reduced its emissions by 99% (24.7 tonnes), contributing to 80% of the overall mercury emissions reduction. The decline was due primarily to changes in facility processes and adoption of emission-reduction technologies, the closing of facilities, and compliance with federal and provincial legislation and guidelines introduced over this period.

Emissions from incineration and waste, and electric utilities (mostly coal power plants), which declined by about two-thirds (2.3 tonnes and 1.6 tonnes, respectively) contributed a further 7% and 5% to the total decrease in emissions over this period.

Mercury is a naturally occurring metal. It can be emitted to the air by:

- natural processes such as volcanic activity and soil and rock erosion
- human activities such as metal smelting, iron and steel production, coal-fired electricity generation, industrial boilers, cement kilns and waste incineration
- improper disposal of products containing mercury such as electrical switches and fluorescent lights

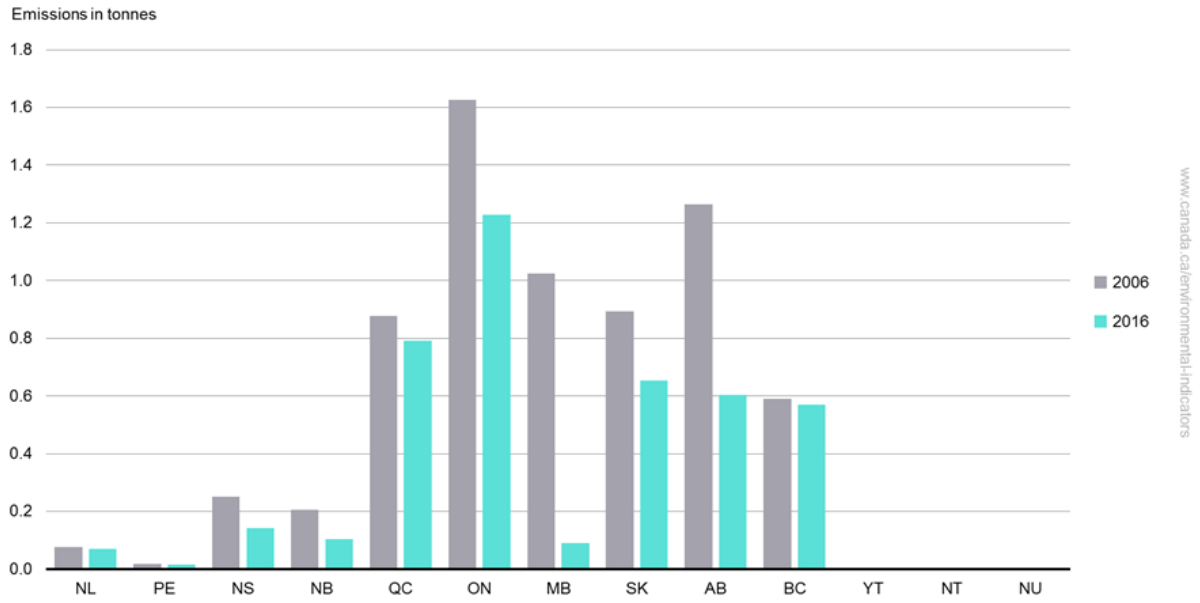
Mercury has significant negative effects on human health and the environment. Its presence persists and bioaccumulates in ecosystems. Canadians' exposure to mercury poses a particular risk to populations such as Indigenous people, who rely heavily on the consumption of predatory fish, such as freshwater trout or Arctic char, and traditional food items, including marine mammals.

Mercury emissions to air by province and territory

Key results

- In 2016, Ontario, Quebec and Saskatchewan accounted for 29%, 18% and 15% of national mercury emissions, respectively
- Between 2006 and 2016, Manitoba had the largest reduction in emissions with a decrease of 91% (or 0.9 tonnes)

Figure 3. Mercury emissions to air by province and territory, Canada, 2006 and 2016



Data for Figure 3

Note: This indicator reports emissions from human activities only.
Source: Environment and Climate Change Canada (2018) Air Pollutant Emission Inventory.

Mercury emissions were the highest in Ontario in 2016, accounting for 29% (1.2 tonnes) of the national total. These emissions mostly came from incineration and waste, and the iron and steel industries, which together accounted for 60% of the total provincial emissions.

Manitoba had the largest decline in emissions between 2006 and 2016. This decline was mostly due to changes in production levels and the closure of an outdated smelter at a non-ferrous mining and smelting facility.

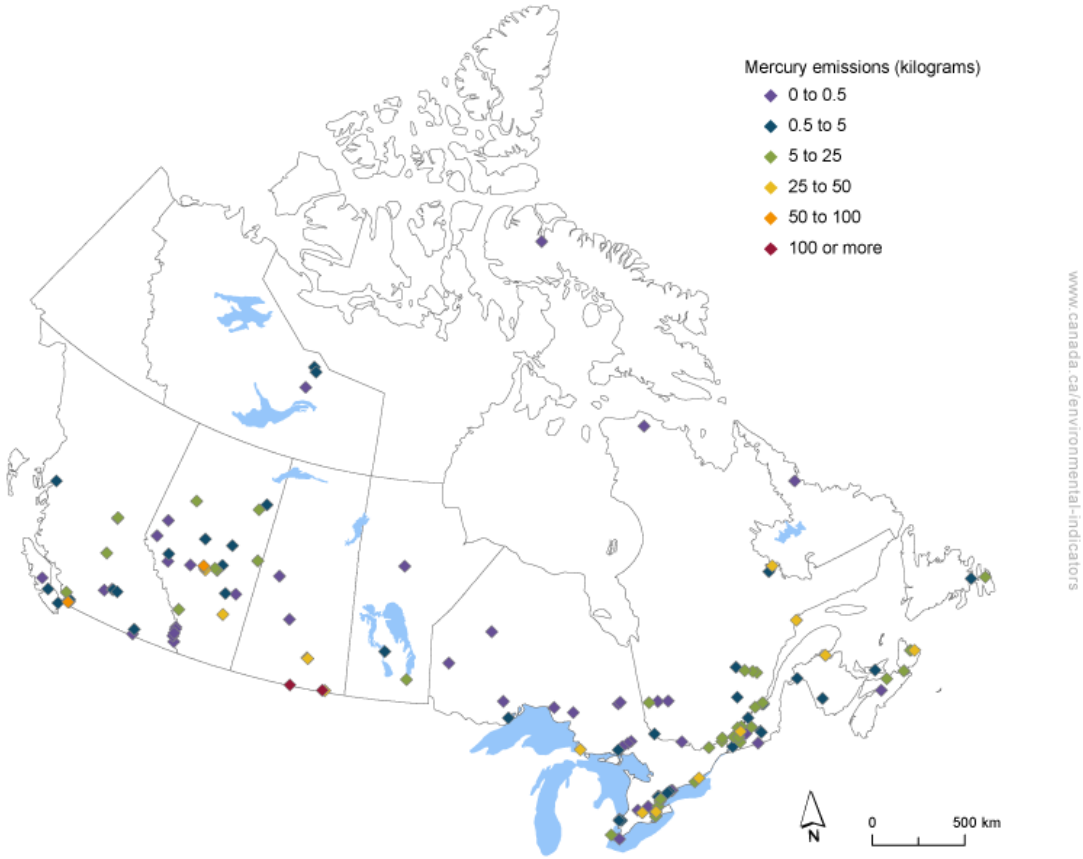
In 2016, incineration and waste was the largest source of emissions in Ontario, Quebec, British Columbia, Manitoba, Prince Edward Island, Yukon and Nunavut. The largest source in Saskatchewan, Alberta and Nova Scotia was electric utilities (mostly coal power plants). In Newfoundland and Labrador, the Northwest Territories and New Brunswick, the largest sources were the iron ore industry, mining and rock quarrying, and the non-ferrous mining and smelting industry, respectively.

Mercury emissions to air from facilities

The National Pollutant Release Inventory provides detailed information on emissions from industrial, commercial and institutional facilities that meet its reporting criteria.

The Environmental Indicators provide access to this information through an online interactive map. With this map, you can focus on local areas and get details on mercury emissions to air from individual facilities.

Figure 4. Mercury emissions to air by facility, Canada, 2016



Navigate data using the interactive map

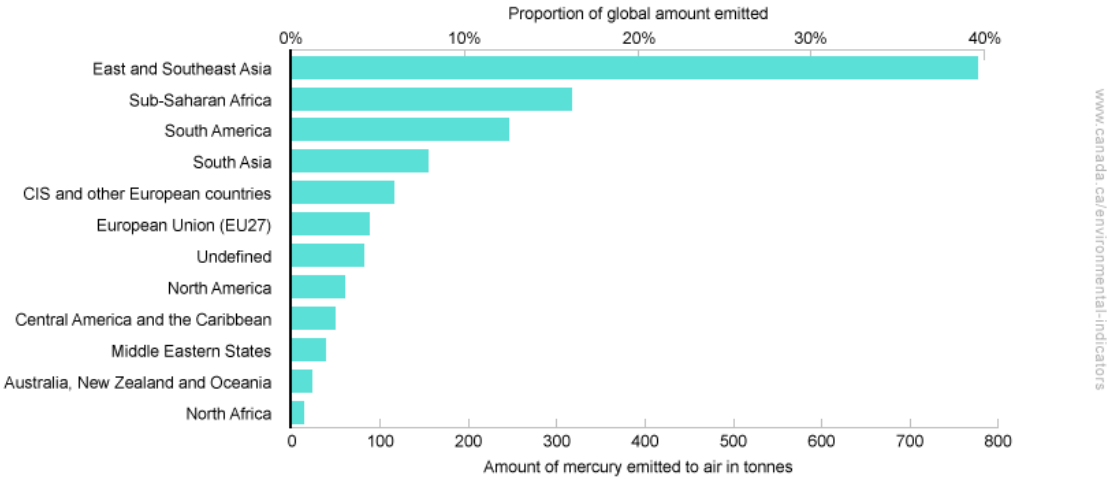
Source: Environment and Climate Change Canada (2017) National Pollutant Release Inventory Data Search - 2016 Facility Reported Data.

Global mercury emissions to air

Key results

- In 2010, global mercury emissions[2] to air from human activity were estimated to be 1 960 tonnes
- East and Southeast Asia, Sub-Saharan Africa and South America accounted for 68% of the global total
    - China alone contributed about 30% to the global total
- North America emitted 61 tonnes, or about 3.1% of the global total
    - Canada emitted less than 5 tonnes or about 0.3% of the global total

Figure 5. Global mercury emissions to air, 2010



Data for Figure 5

Note: CIS = Commonwealth of Independent States. CIS includes Azerbaijan, Armenia, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russian Federation, Tajikistan, Turkmenistan, Uzbekistan and Ukraine. The Undefined region includes emissions from contaminated sites.
Source: United Nations Environmental Program, Chemicals Branch (2013) Global Mercury Assessment 2013: Sources, emissions, releases, and environmental transport.

Mercury emissions can travel hundreds to thousands of kilometres via air masses before being deposited.[3] For example, the 2016 Canadian Mercury Science Assessment estimated that over 95% of the human-related mercury deposited in Canada came from sources outside of the country (40% from East Asia, 17% from the United States, 8% from Europe and 6% from South Asia).

[2] United Nations Environment Programme, Chemicals Branch (2013) Transport Global. The global emissions were calculated by the United Nations Environment Programme and are independent of Canada's mercury emission estimates. The use of different calculation estimates and different source classifications account for the differences in Canada's mercury emissions as reported in the global comparison indicator and in the Canadian mercury indicator for 2010.

[3] Durnford D et al. (2010) Long range transport of mercury to the Arctic and across Canada. Atmospheric Chemistry and Physics 10(2):4673–4717. Retrieved on April 5, 2018.

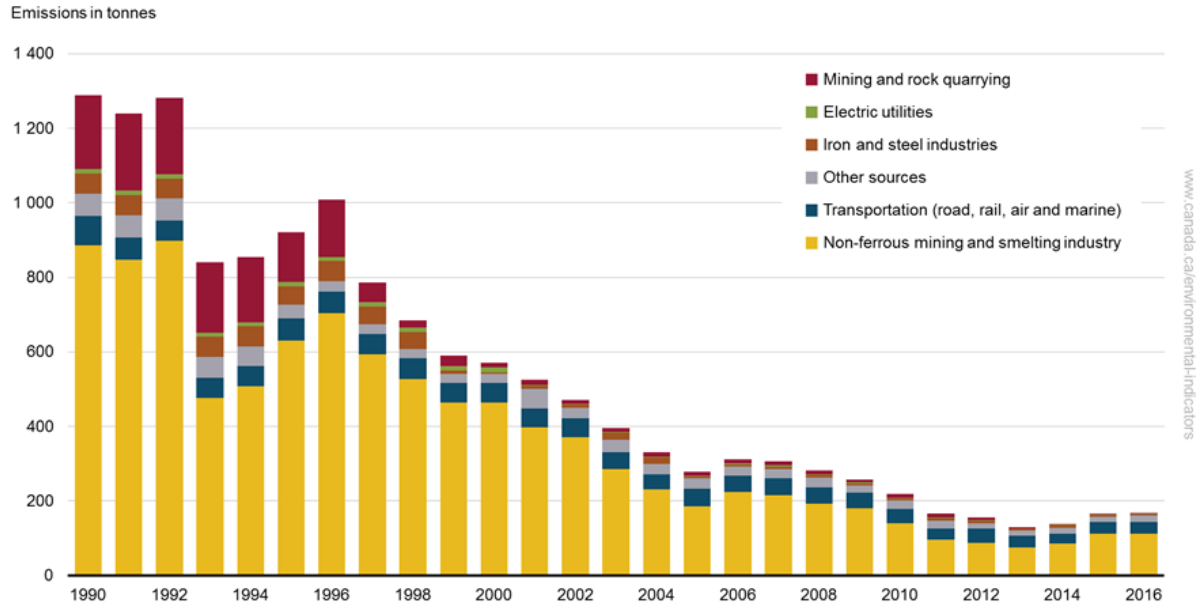
Emissions of lead to air

Lead can be deposited on land or water surfaces and then build up in soils, sediments, humans and wildlife. Canadians are exposed to low levels of lead through food, drinking water, air, household dust, soil and various products. Exposure to lead, even in small amounts, can be hazardous to both humans and wildlife.

Key results

- Lead emissions decreased by 87% (or 1 120.9 tonnes) between 1990 and 2016
- Since 1990, the largest source of lead emissions has been the non-ferrous mining and smelting industry, accounting for 66% (or 111.7 tonnes) of the total in 2016

Figure 6. Lead emissions to air by source, Canada, 1990 to 2016



Data for Figure 6

Note: The indicator reports emissions from human activities only. The category "other sources" includes agriculture (livestock, crop production and fertilizer), building heating and energy generation, home firewood burning, incineration and waste, manufacturing, the oil and gas industry, ore and mineral industries (except for the iron and steel industries, the non-ferrous mining and smelting industry, and mining and rock quarrying), paints and solvents and other miscellaneous sources. For more details on the sources, consult Table 1.
Source: Environment and Climate Change Canada (2018) Air Pollutant Emission Inventory.

Between 1990 and 2016, emissions from the non-ferrous mining and smelting industry declined by 774.6 tonnes due to the introduction of pollution prevention plans and strategies in operating smelters, along with the closure of outdated smelters. During this period, emissions from mining and rock quarrying declined by 197.7 tonnes. Combined, these 2 sources contributed to 87% of the decline in lead emissions from 1990 to 2016.

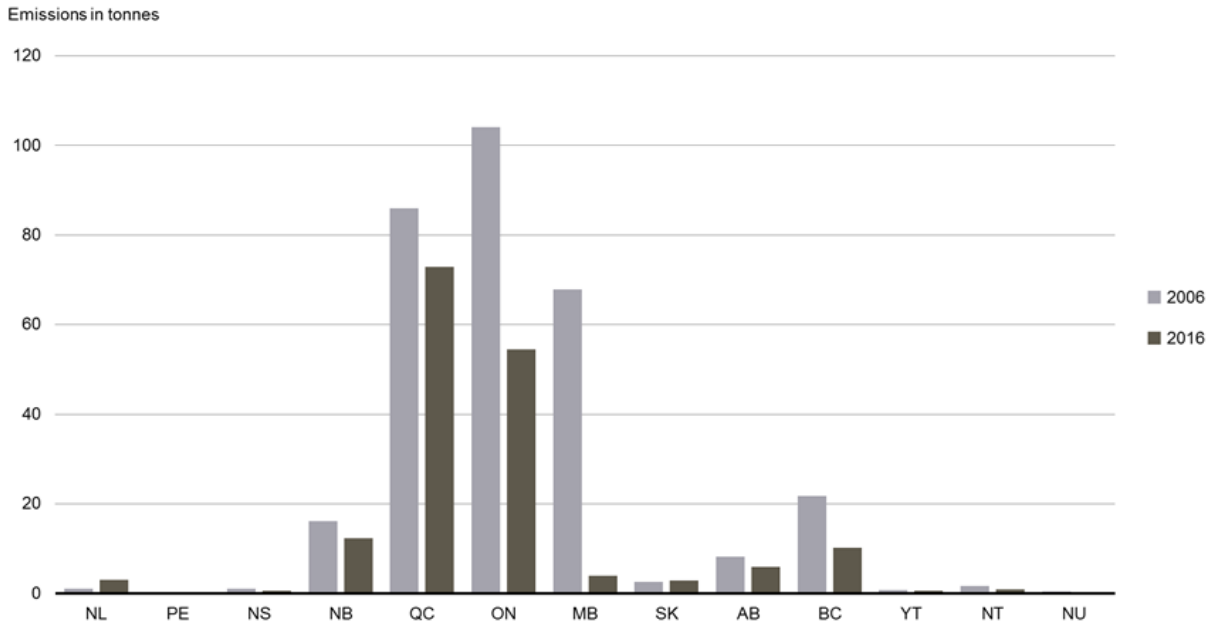
Lead is a metal that occurs naturally in the Earth's crust and can be released during natural processes such as rock and soil erosion. Most lead emissions come from of industrial activities, such as metal mining and smelting, and various combustion processes.

Lead emissions to air by province and territory

Key results

- In 2016, Quebec and Ontario accounted for 76% of national lead emissions
- Between 2006 and 2016, Manitoba had the largest decrease in emissions with a decrease of 94% (or 63.9 tonnes)

Figure 7. Lead emissions to air by province and territory, Canada, 2006 and 2016



Data for Figure 7

Note: The indicator reports emissions from human activities only.
Source: Environment and Climate Change Canada (2018) Air Pollutant Emission Inventory.

Between 2006 and 2016, lead emissions increased in Newfoundland and Labrador and Saskatchewan by 1.9 tonnes and 0.3 tonnes, respectively. In Newfoundland and Labrador, this change was primarily due to increases in emissions from the iron ore industry and electric utilities. In Saskatchewan, the change was primarily due to increases in emissions from electric utilities and the oil and gas industry.

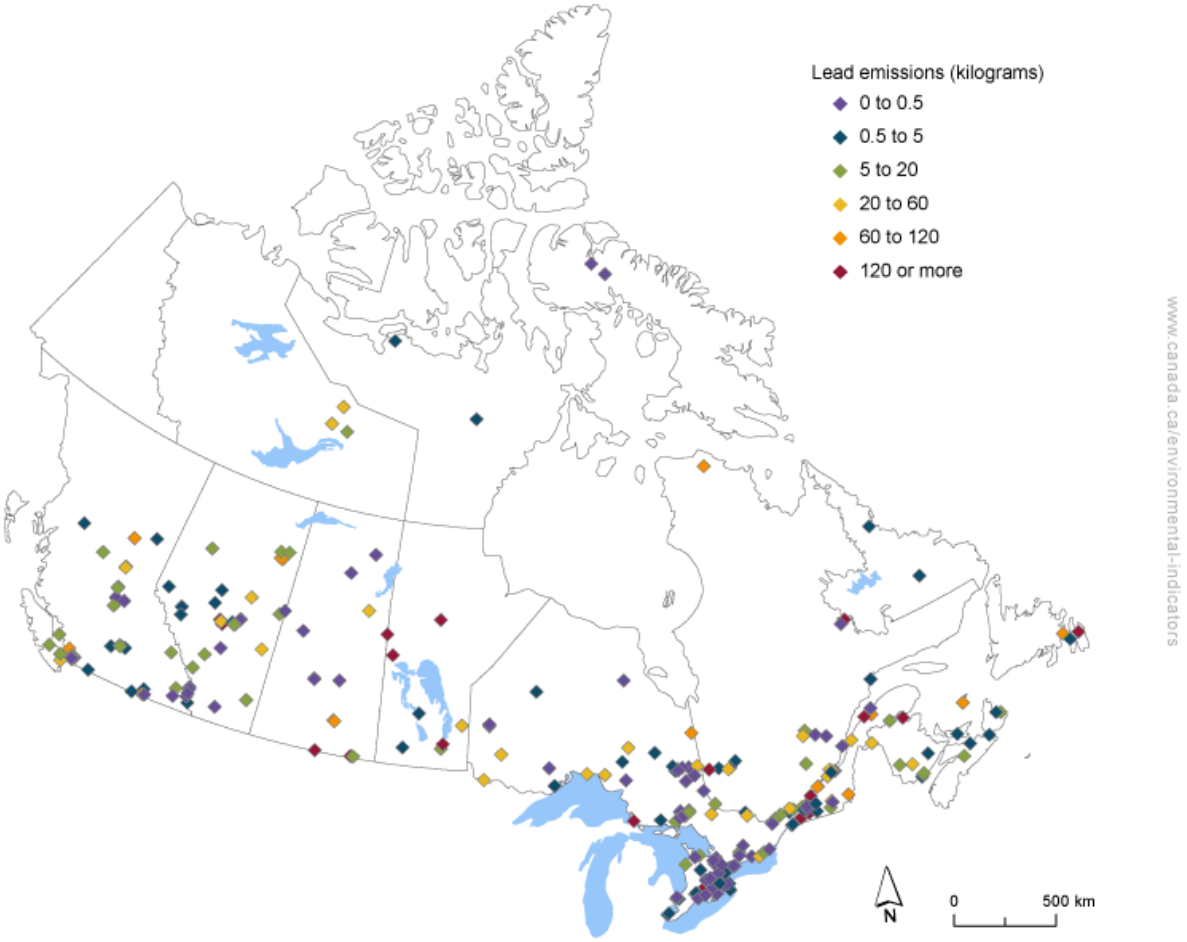
In 2016, lead emission levels in Quebec were the highest in Canada, accounting for 43% (73 tonnes) of national emissions. The non-ferrous mining and smelting industry was the largest source of lead emissions in Quebec, Ontario and New Brunswick. Transportation (road, rail, air and marine) was the main source of emissions in all other provinces and territories except Newfoundland and Labrador, where the main source was the iron ore industry.

Lead emissions to air from facilities

The National Pollutant Release Inventory provides detailed information on emissions from industrial, commercial and institutional facilities that meet its reporting criteria.

The Environmental Indicators provide access to this information through an online interactive map. With this map, you can focus on local areas and get details on lead emissions to air from individual facilities.

Figure 8. Lead emissions to air by facility, Canada, 2016



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2017) National Pollutant Release Inventory Data Search - 2016 Facility Reported Data.

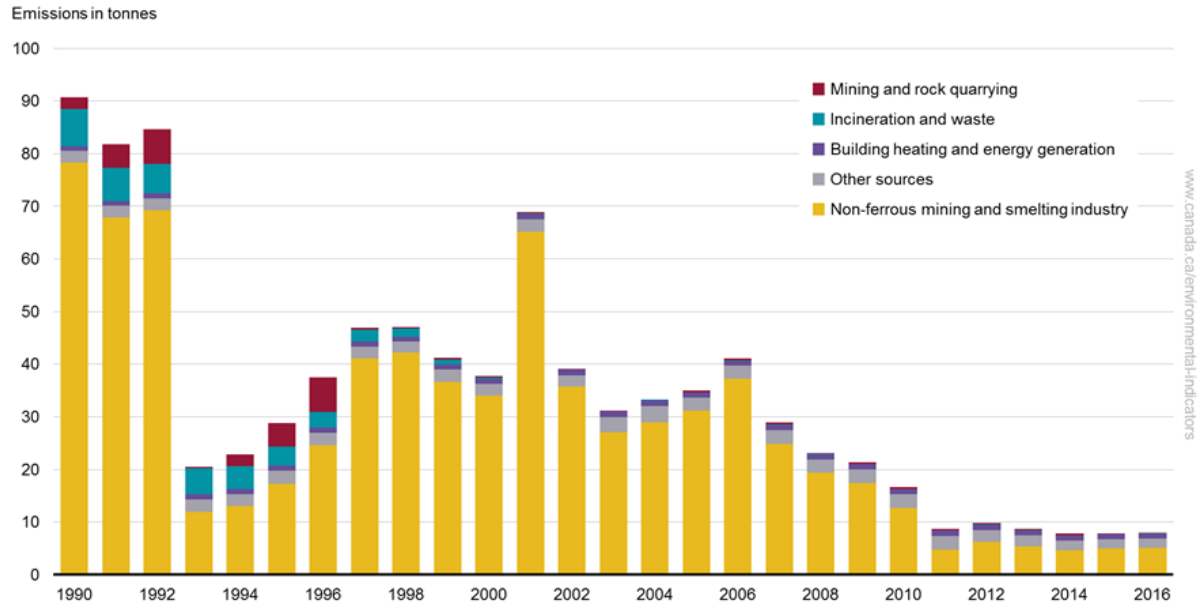
Emissions of cadmium to air

Cadmium is a naturally occurring metal. It is used in batteries and in electroplating to protect other metals from corrosion. Exposure to cadmium can be hazardous to both humans and wildlife.

Key results

- Cadmium emissions were 91% (or 82.8 tonnes) lower in 2016 than in 1990
- The non-ferrous mining and smelting industry contributed to 88% of the decrease in emissions between 1990 and 2016
    - fluctuations observed in this source prior to 2010 are attributed to a single smelter in Manitoba

Figure 9. Cadmium emissions to air by source, Canada, 1990 to 2016



Data for Figure 9

Note: The indicator reports emissions from human activities only. The category "other sources" includes agriculture (livestock, crop production and fertilizer), electric utilities, home firewood burning, manufacturing, the oil and gas industry, ore and mineral industries (except for the non-ferrous mining and smelting industry, and mining and rock quarrying), paints and solvents, transportation (road, rail, air and marine) and other miscellaneous sources. For more details on the sources, consult Table 1.
Source: Environment and Climate Change Canada (2018) Air Pollutant Emission Inventory.

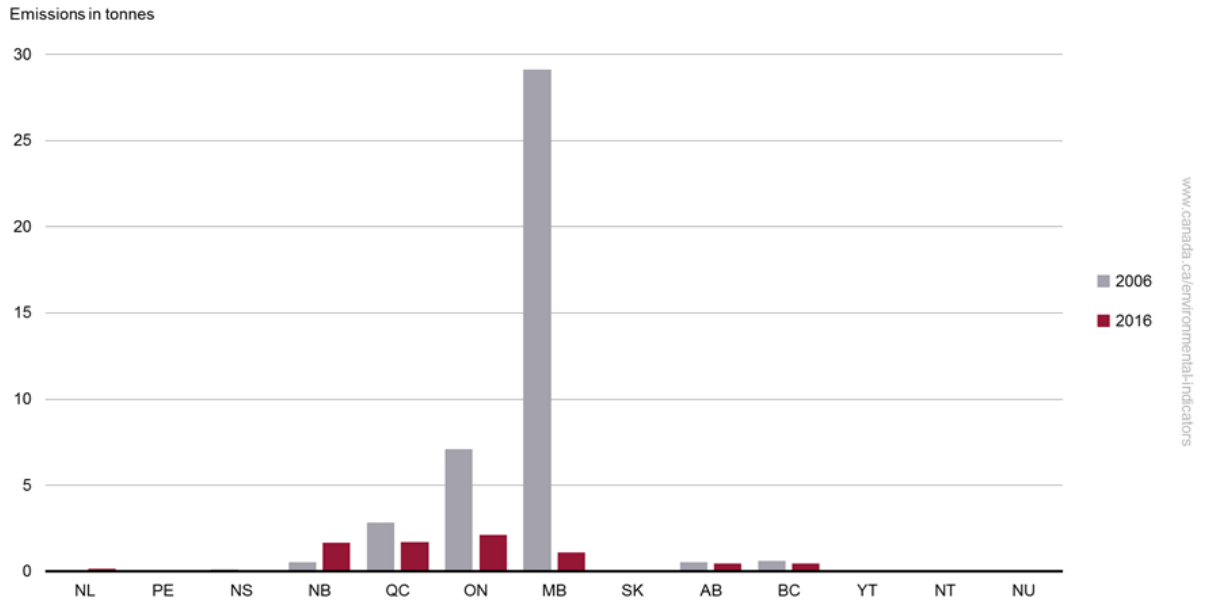
Between 1990 and 2016, cadmium emissions from the non-ferrous mining and smelting industry declined by 73.2 tonnes due to the closure of outdated smelters and the introduction of pollution prevention plans. Emissions from incineration and waste declined by 7.0 tonnes over the same period. Combined, these 2 sources contributed to 97% of the decline in cadmium emissions between 1990 and 2016.

Cadmium emissions to air by province and territory

Key results

- In 2016, Ontario, Quebec, New Brunswick and Manitoba accounted for 84% of national cadmium emissions
- Between 2006 and 2016, Manitoba had the largest decrease in emissions with a decrease of 96% (or 28.0 tonnes)
    - this was mostly due to a change in production levels and to the introduction of pollution prevention activities at a non-ferrous mining and smelting facility

Figure 10. Cadmium emissions to air by province and territory, Canada, 2006 and 2016



Data for Figure 10

Note: The indicator reports emissions from human activities only.
Source: Environment and Climate Change Canada (2018) Air Pollutant Emission Inventory.

Between 2006 and 2016, New Brunswick had a 1.1 tonne increase in cadmium emissions. This increase was mostly due to a change in production levels at a facility.

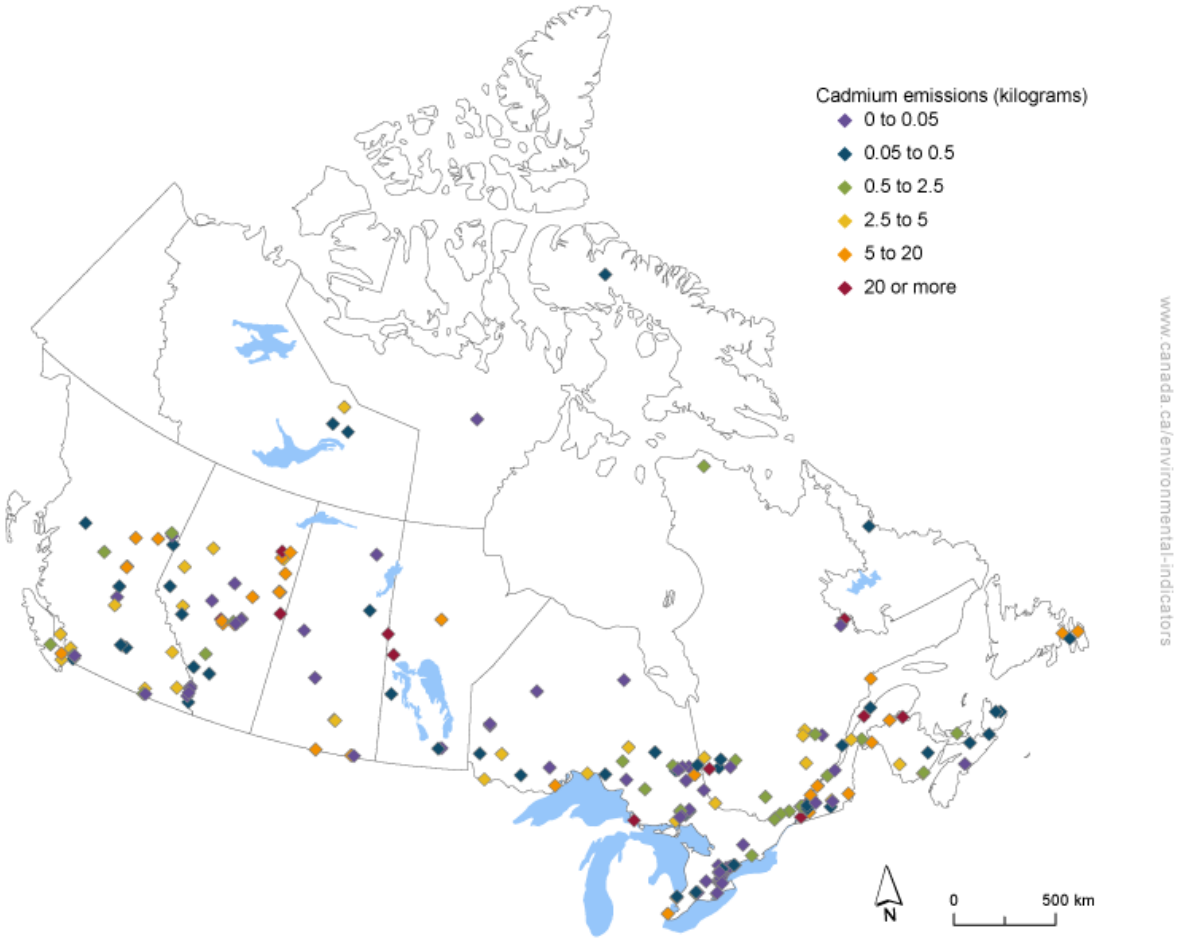
In 2016, Ontario had the highest level of cadmium emissions, accounting for 27% of national emissions. Non-ferrous mining and smelting was the main source of cadmium emissions in New Brunswick, Ontario, Manitoba, Quebec and British Columbia. Building heating and energy generation were the main sources of emissions in all the other provinces and territories, except for Newfoundland and Labrador, and Nunavut, where the main sources were the iron ore industry and transportation (road, rail, air and marine), respectively.

Cadmium emissions to air from facilities

The National Pollutant Release Inventory provides detailed information on emissions from industrial, commercial and institutional facilities that meet its reporting criteria.

The Environmental Indicators provide access to this information through an online interactive map. With this map, you can focus on local areas and get details on cadmium emissions to air from individual facilities.

Figure 11. Cadmium emissions to air by facility, Canada, 2016



Navigate this data using the interactive map

Source: Environment and Climate Change Canada (2017) National Pollutant Release Inventory Data Search - 2016 Facility Reported Data.

About the indicators

What the indicators measure

These indicators track human-related emissions to air of 3 substances that are defined as toxic under the Canadian Environmental Protection Act, 1999: mercury, lead and cadmium and their compounds. For each toxic substance, data are provided at the national, regional (provincial and territorial) and facility level and by source. Global emissions data are also provided for mercury.

Why these indicators are important

Mercury and its compounds, lead and inorganic cadmium compounds are on the Toxic Substances List under Schedule 1 of the Canadian Environmental Protection Act, 1999. This means that these substances are "entering or may enter the environment in a quantity or concentration or under conditions that (a) have or may have an immediate or long-term harmful effect on the environment or its biological diversity; (b) constitute or may constitute a danger to the environment on which life depends; or (c) constitute or may constitute a danger in Canada to human life or health."

The indicators inform Canadians about emissions to air of these 3 substances from human activity in Canada. These indicators also help the government to identify priorities and develop or revise strategies to inform further risk management and to track progress on policies put in place to reduce or control these 3 substances and air pollution in general.

Related indicators

The Releases of harmful substances to water indicators track human-related releases to water of 3 toxic substances, namely mercury, lead and cadmium, and their compounds. For each toxic substance, data are provided at the national, regional (provincial and territorial) and facility level and by source.

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

Safe and healthy communities

These indicators support the measurement of progress towards the following 2016–2019 Federal Sustainable Development Strategy long-term goal: All Canadians live in clean, sustainable communities that contribute to their health and well-being.

Data sources and methods

Data sources

Data for the indicators are based on emission estimates reported in the Air Pollutant Emission Inventory. The inventory data are available online on the Open Data website. Facility data for the interactive maps come from the National Pollutant Release Inventory.

Global mercury emissions data were taken from the United Nations Environment Programme's Global Mercury Assessment 2013 report.

More information

The Air Pollutant Emission Inventory provides data and estimates on releases of air pollutants from human activities. These pollutants contribute to the issues of smog, acid rain, reduced air quality and climate change. Improvements to the inventory are made periodically as new emission estimation methods are adopted and additional information is made available. Historical emissions are updated on the basis of these improvements.

Air Pollutant Emission Inventory

This inventory fulfills many of Canada's international reporting obligations on pollution. It is a comprehensive inventory of 17 air pollutants[4] that combines facility emissions reported to the National Pollutant Release Inventory with non-facility emissions estimated by Environment and Climate Change Canada (the department). Estimates are developed using the latest estimation methods and are largely based on published statistics or other sources of information, such as surveys and reports. The Air Pollutant Emission Inventory provides a comprehensive overview of pollutant emissions across Canada.

The national and provincial/territorial inventory data are current as of March 20, 2018, and cover the period from 1990 to 2016. Emissions data are reported in the inventory approximately 1 year after data collection, validation, calculation and interpretation have been completed. The indicators are reported following the public release of the inventory data.

National Pollutant Release Inventory

The inventory is a database of pollutant releases (to air, water and land), disposals and transfers for recycling from industrial, commercial and institutional facilities. The data from these facilities are provided by facility operators as mandated by the Canadian Environmental Protection Act, 1999. Under the act, owners or operators of facilities that manufacture, process or otherwise use or release one or more of the substances tracked by the inventory and that meet substance-specific reporting thresholds and other requirements must report their pollutant releases, disposals and transfers annually to the department. The inventory data from 1994 to 2016 are current as of September 14, 2017.

Global Mercury Assessment

The Global Mercury Assessment 2013: Sources, emissions, releases and environmental transport and its Technical Background Report represent the second edition of the United Nations Environment Programme reporting on global mercury emissions. This edition was based on national emissions data for 2010. An update of the assessment is planned for late 2018.The global mercury emissions to air indicator is provided for 2010, the latest year that data are available.

[4] Includes the 6 key air pollutants (sulphur oxides, nitrogen oxides, volatile organic compounds, ammonia, carbon monoxide and fine particulate matter) along with cadmium, lead, mercury, dioxins and furans, 4 types of polycyclic aromatic hydrocarbons, hexachlorobenzene, particulate matter less than or equal 10 microns and total particulate matter.

Methods

The indicators are produced by grouping the calculated emissions data from Canada's national inventories to report on the key sources that contribute to the majority of mercury, lead and cadmium emissions.

More information

Compilation of emissions

The Air Pollutant Emission Inventory is developed using two types of information:

- facility-reported data, consisting of emissions from relatively large industrial, commercial and institutional facilities
- in-house estimates, including diffuse sources and other sources that are too numerous to be accounted for individually, such as road and non-road vehicles, agricultural activities, construction and solvent use

The Air Pollutant Emission Inventory is developed using many sources of information, procedures and emission estimation models. Emissions data reported by individual facilities to the department's National Pollutant Release Inventory are supplemented with documented, science-based estimation tools to quantify total emissions. Together, these data sources provide a comprehensive overview of pollutant emissions across Canada.

A compilation framework has been developed that makes use of the best available data, while ensuring that there is no double-counting or omissions. Additional information on the inventory compilation process is provided in Annex 2 of the Air Pollutant Emission Inventory Report.

Facility-reported emissions data

Facility-reported emissions data generally refers to any stationary sources that emit pollutants through stacks or other equipment at specific locations. The major source of facility-reported data is the National Pollutant Release Inventory.

Facility-reported data from the National Pollutant Release Inventory are used in the Air Pollutant Emission Inventory without modifications, except when data quality issues are detected and not addressed during the quality control exercise. The National Pollutant Release Inventory reporting requirements and thresholds vary by pollutant and, in some cases, by industry. Details on these reporting requirements and thresholds are available on the National Pollutant Release Inventory website.

A distinction has been made between reporting facilities and non-reporting facilities. Reporting facilities meet the threshold required to report to the National Pollutant Release Inventory, while non-reporting facilities do not meet these thresholds due to their size or emission levels, and therefore are not required to report to the inventory. Some facilities may be required to report emissions on only certain pollutants. Therefore, emissions from the non-reporting facilities or of non-reported pollutants must be estimated in-house to ensure complete coverage.

In-house emission estimates

In-house estimates are calculated with information such as production data and activity data, using various estimation methodologies and emission models. These emission estimates are at the national level rather than at any specific geographic locations. The Air Pollutant Emission Inventory uses in-house estimates for the following emission sources:

- any residential, governmental, institutional or commercial operation that does not report to the National Pollutant Release Inventory
- on-site solid waste disposal facilities
- motor vehicles, aircraft, vessels or other transportation equipment or devices

- other sources, such as open burning, agricultural activities and construction operations

In general, in-house emission estimates are calculated from activity data and emission factors.[5] Activity data usually comprise statistical production or process data at the provincial, territorial or national level. This information is typically provided by provincial/territorial agencies, federal government departments, industry associations, etc. For each source category, activity data are combined with emission factors to produce provincial/territorial-level emission estimates.

The in-house emission estimate methodologies and emission models used in Canada are often based on those developed by the United States Environmental Protection Agency (U.S. EPA) and are adapted to reflect the Canadian climate, fuels, technologies and practices. Methods used in Canada's Air Pollutant Emission Inventory are therefore generally consistent with those used in the United States or those recommended in the emission inventory guidebook.[6]

The Air Pollutant Emission Inventory reports air pollutant emissions from mobile sources such as on-road vehicles, off-road vehicles and engines. For the current edition of the Air Pollutant Emission Inventory, an emissions estimation model developed by the U.S. EPA (MOVES) was used. The emissions for off-road vehicles and engines (such as graders, heavy trucks, outboard motors and lawnmowers) were estimated using the U.S. EPA's NONROAD emission estimation model (see "off-road vehicles and equipment" in Table A2-5 of Annex 2 of the Air Pollutant Emission Inventory Report). The parameters in both models were modified to take into account variations in the Canadian vehicle fleet, emission control technologies, types of fuels, vehicle standards, and types of equipment engines and their application in various industries. The emission estimates for civil and international aviation, railways and navigation are estimated using detailed vehicle movement statistics coupled with fuel consumption, engine information and emission rates by vehicle types.

Recalculations

Emission recalculation is an essential practice in the maintenance of an up-to-date air pollutant emission inventory. The Air Pollutant Emission Inventory is continuously updated with improved estimation methodologies, statistics, and more recent and appropriate emission factors. As new information and data become available, previous estimates are updated and recalculated to ensure a consistent and comparable trend in emissions. Recalculations of previously reported emission estimates are common for both in-house estimates and facility-reported emission data. More information on recalculations is provided in Annex 2 of the Air Pollutant Emission Inventory Report.

Emissions reconciliation

In several sectors, estimation of total emissions involves combining estimates provided by facilities with estimates developed in-house by the department. To prevent double counting of emissions and to confirm that the Air Pollutant Emission Inventory includes all emissions, a comparison and reconciliation of emission estimates from various sources is performed for each pollutant, industry sector and geographical region, as appropriate. More information on the reconciliation process is provided in Annex 2 of the Air Pollutant Emission Inventory Report.

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[5] The United States Environmental Protection Agency defines an emission factor as "…a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (for example, kilograms of particulate emitted per megagram of coal burned)."

[6] European Monitoring and Evaluation Programme/European Environment Agency (2013) EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013. Technical Guidance to Prepare National Emission Inventories. Luxembourg: Publications Office of the European Union. Technical Report No. 12/2013.

Temporal coverage

Historical data are provided at the national and source level for the period from 1990 to 2016. For the regional indicators (provincial/territorial), emissions are presented for 2006 and 2016.

Air pollutant emissions by source classification

For the purposes of reporting the indicators, calculated emissions data from the Air Pollutant Emission Inventory are grouped into the following 13 sources:

- agriculture (livestock, crop production and fertilizer)
- building heating and energy generation
- dust and fires
- electric utilities
- home firewood burning
- incineration and waste
- manufacturing
- miscellaneous
- off-road vehicles and mobile equipment
- oil and gas industry
- ore and mineral industries
- paints and solvents
- transportation (road, rail, air and marine)

Table 1 shows the allocation of sources of harmful substances reported in the indicators compared with the sources and sectors reported by the Air Pollutant Emission Inventory.

Table 1. Alignment of sources reported in the indicators with the sources and sectors from the Air Pollutant Emission Inventory

Sources in the indicators	Sources and sectors in the Air Pollutant Emission Inventory
Agriculture (livestock, crop production and fertilizer)	Agriculture: Crop production
Agriculture (livestock, crop production and fertilizer)	Agriculture: Fuel use
Agriculture (livestock, crop production and fertilizer)	Agriculture: Animal production
Building heating and energy generation	Commercial/Residential/Institutional: Commercial and institutional fuel combustion
Building heating and energy generation	Commercial/Residential/Institutional: Residential fuel combustion
Building heating and energy generation	Commercial/Residential/Institutional: Construction fuel combustion
Dust and fires	Fires: Structural fires
Dust and fires	Fires: Prescribed forest burning
Dust and fires	Dust: Construction operations

Sources in the indicators	Sources and sectors in the Air Pollutant Emission Inventory
Dust and fires	Dust: Paved roads
Dust and fires	Dust: Unpaved roads
Dust and fires	Dust: Coal transportation
Dust and fires	Dust: Mine tailings
Electric utilities	Electric power generation (utilities): Coal
Electric utilities	Electric power generation (utilities): Natural gas
Electric utilities	Electric power generation (utilities): Diesel
Electric utilities	Electric power generation (utilities): Other electric power generation
Electric utilities	Electric power generation (utilities): Waste materials[A]
Home firewood burning	Commercial/Residential/Institutional: Home firewood burning
Incineration and waste	Incineration and waste sources: Crematoriums
Incineration and waste	Incineration and waste sources: Waste incineration
Incineration and waste	Incineration and waste sources: Waste treatment and disposal
Manufacturing	Manufacturing: Chemical industry
Manufacturing	Manufacturing: Grain industries
Manufacturing	Manufacturing: Pulp and paper industry
Manufacturing	Manufacturing: Wood products
Manufacturing	Manufacturing: Metal fabrication
Manufacturing	Manufacturing: Glass manufacture
Manufacturing	Manufacturing: Vehicle manufacture (engines, parts, assembly, painting)
Manufacturing	Manufacturing: Electronics
Manufacturing	Manufacturing: Plastics manufacture
Manufacturing	Manufacturing: Food preparation
Manufacturing	Manufacturing: Textiles
Manufacturing	Manufacturing: Abrasives manufacture

Sources in the indicators	Sources and sectors in the Air Pollutant Emission Inventory
Manufacturing	Manufacturing: Bakeries
Manufacturing	Manufacturing: Other industries
Manufacturing	Manufacturing: Biofuel production
Miscellaneous	Commercial/Residential/Institutional: Cigarette smoking
Miscellaneous	Commercial/Residential/Institutional: Marine cargo handling industry
Miscellaneous	Commercial/Residential/Institutional: Commercial cooking
Miscellaneous	Commercial/Residential/Institutional: Service stations
Miscellaneous	Commercial/Residential/Institutional: Human[B]
Miscellaneous	Commercial/Residential/Institutional: Other miscellaneous sources
Off-road vehicles and mobile equipment	Transportation and mobile equipment: Off-road diesel vehicles and equipment
Off-road vehicles and mobile equipment	Transportation and mobile equipment: Off-road gasoline, liquefied petroleum gas, compressed natural gas vehicles and equipment
Oil and gas industry	Oil and gas industry: Upstream oil and gas industry
Oil and gas industry	Oil and gas industry: Downstream oil and gas industry
Ore and mineral industries	Ore and mineral industries: Aluminum industry
Ore and mineral industries	Ore and mineral industries: Asphalt paving industry
Ore and mineral industries	Ore and mineral industries: Cement and concrete industry
Ore and mineral industries	Ore and mineral industries: Mineral products industry
Ore and mineral industries	Ore and mineral industries: Foundries
Ore and mineral industries	Ore and mineral industries: Iron and steel industries[C]
Ore and mineral industries	Ore and mineral industries: Iron ore industry
Ore and mineral industries	Ore and mineral industries: Mining and rock quarrying[C]
Ore and mineral industries	Ore and mineral industries: Non-ferrous mining and smelting industry[C]
Paints and solvents	Paints and solvents: Dry cleaning

Sources in the indicators	Sources and sectors in the Air Pollutant Emission Inventory
Paints and solvents	Paints and solvents: General solvent use
Paints and solvents	Paints and solvents: Printing
Paints and solvents	Paints and solvents: Surface coatings
Transportation (road, rail, air and marine)	Transportation and mobile equipment: Air transportation
Transportation (road, rail, air and marine)	Transportation and mobile equipment: Heavy-duty diesel vehicles
Transportation (road, rail, air and marine)	Transportation and mobile equipment: Heavy-duty gasoline vehicles
Transportation (road, rail, air and marine)	Transportation and mobile equipment: Light-duty diesel trucks
Transportation (road, rail, air and marine)	Transportation and mobile equipment: Light-duty diesel vehicles
Transportation (road, rail, air and marine)	Transportation and mobile equipment: Light-duty gasoline trucks
Transportation (road, rail, air and marine)	Transportation and mobile equipment: Light-duty gasoline vehicles
Transportation (road, rail, air and marine)	Transportation and mobile equipment: Marine transportation
Transportation (road, rail, air and marine)	Transportation and mobile equipment: Motorcycles
Transportation (road, rail, air and marine)	Transportation and mobile equipment: Rail transportation
Transportation (road, rail, air and marine)	Transportation and mobile equipment: Tire wear and brake lining
Transportation (road, rail, air and marine)	Transportation and mobile equipment: Heavy-duty liquefied petroleum gas / natural gas vehicles
Transportation (road, rail, air and marine)	Transportation and mobile equipment: Light-duty liquefied petroleum gas / compressed natural gas trucks
Transportation (road, rail, air and marine)	Transportation and mobile equipment: Light-duty liquefied petroleum gas / compressed natural gas vehicles

Note: [A] Includes electric power generation from combustion of waste materials by utilities and by industry for commercial sale and/or private use. [B] Includes human respiration, perspiration and dental amalgams. [C] These sectors from the Air Pollutant Emission Inventory are sometimes shown as individual sources in the indicators.

For display purposes, smaller emitting sources are sometimes grouped together under the title "Other sources" in the charts of emissions by source. The names of the grouped sources are listed in the notes of each chart.

Recent changes

This update includes maps for lead and cadmium emissions to air by facilities.

Caveats and limitations

Total emissions of mercury, lead and cadmium to air reported in these indicators exclude natural sources such as forest fires.

To provide a consistent global picture, Canadian mercury emissions data used for the international comparison came from the United Nations Environment Programme's Global Mercury Assessment 2013: Sources, emissions, releases and environmental transport report. However, it is important to note that the emissions data found in this report were estimated using different estimation techniques and different source classifications than the data used for the national indicators. In addition, some sources were not quantified in the international comparison due to a lack of data.

More information

Air Pollutant Emission Inventory and National Pollutant Release Inventory

The methods used to estimate air pollutant emissions continue to evolve. In general, improvements are made every year to methodologies for estimating emissions. As a result of these improvements, emissions for a given year may differ from those previously published by the department. Caution is advised when comparing different reports and different sources.

The Air Pollutant Emission Inventory uses facility information from the National Pollutant Release Inventory and other sources. The version of the data published by the National Pollutant Release Inventory may not be identical to that used in the Air Pollutant Emission Inventory at any given time because of updates to facility-reported data from the National Pollutant Release Inventory.

The number and composition of facilities that report releases to air to the National Pollutant Release Inventory can vary each year. This variation is due to the fact that only facilities that meet or exceed the reporting threshold are required to report to the inventory. An analysis of how this might affect the apparent trends has not been undertaken.

Facilities reporting to the National Pollutant Release Inventory may use different methods to calculate releases. The methods vary depending on the substance and/or facility, and may change from year to year.

Global mercury emissions

Air emissions sources that were not quantified in the international mercury emissions comparison include:

- biofuel production and combustion
- vinyl-chloride monomer production
- secondary metals production and ferro-alloys
- oil and gas extraction
- transport and processing other than refinery emissions
- industrial/hazardous waste incineration and disposal sewage sludge incineration
- preparation of dental amalgam fillings and disposal of removed fillings containing mercury

The Canadian mercury emissions data follows the same reporting structure as the Global Mercury Assessment report and uses the best data, measurements and methods available. Nonetheless, users must be cautious when comparing the data, as emissions estimation methodologies differ among countries.

Resources

References

Environment and Climate Change Canada (2017) Access data from the National Pollutant Release Inventory. September 14, 2017 version. Retrieved on March 22, 2018.

Environment and Climate Change Canada (2018) Air Pollutants Emissions Inventory online search. Retrieved on March 22, 2018.

United Nations Environment Programme (2013) Global Mercury Assessment 2013: Sources, emissions, releases and environmental transport. Retrieved on March 22, 2018.

Related information

Environment and Climate Change Canada (2017) Using and interpreting data from the National Pollutant Release Inventory. Retrieved on March 22, 2018.

Annex

Annex A. Data tables for the figures presented in this document

Table A.1. Data for Figure 1. Mercury, lead and cadmium emissions to air, Canada, 1990 to 2016

Year	Lead (annual percentage change in emissions relative to 1990)	Mercury (annual percentage change in emissions relative to 1990)	Cadmium (annual percentage change in emissions relative to 1990)
1990	0	0	0
1991	-4	0	-10
1992	-1	1	-7
1993	-35	-40	-77
1994	-34	-48	-75
1995	-29	-58	-68
1996	-22	-59	-59
1997	-39	-66	-48
1998	-47	-68	-48
1999	-54	-71	-55
2000	-56	-71	-58
2001	-59	-73	-24
2002	-63	-75	-57
2003	-69	-76	-66
2004	-74	-76	-63
2005	-78	-79	-61
2006	-76	-80	-55
2007	-76	-78	-68
2008	-78	-81	-75
2009	-80	-84	-76
2010	-83	-84	-82
2011	-87	-87	-90

Year	Lead (annual percentage change in emissions relative to 1990)	Mercury (annual percentage change in emissions relative to 1990)	Cadmium (annual percentage change in emissions relative to 1990)
2012	-88	-87	-89
2013	-90	-87	-90
2014	-89	-88	-91
2015	-87	-88	-91
2016	-87	-88	-91

Note: The indicator reports emissions from human activities only.
Source: Environment and Climate Change Canada (2018) Air Pollutant Emission Inventory.

Table A.2. Data for Figure 2. Mercury emissions to air by source, Canada, 1990 to 2016

Year	Other sources (emissions in tonnes)	Incineration and waste (emissions in tonnes)	Electric utilities (emissions in tonnes)	Iron and steel industries (emissions in tonnes)	Non-ferrous mining and smelting industry (emissions in tonnes)	Total (emissions in tonnes)
1990	3.26	3.60	2.30	0.95	24.90	35.01
1991	3.22	3.75	2.17	0.97	24.87	34.98
1992	3.17	3.86	2.40	0.99	24.78	35.20
1993	3.10	3.72	2.19	1.19	10.63	20.84
1994	3.11	3.77	2.11	1.06	8.26	18.30
1995	3.13	4.00	2.04	1.03	4.65	14.84
1996	2.98	2.60	2.14	1.05	5.68	14.46
1997	2.79	2.35	2.29	1.11	3.39	11.93
1998	2.59	2.05	2.42	1.12	2.84	11.03
1999	2.56	1.86	2.42	1.14	2.28	10.24
2000	2.78	2.10	2.14	1.14	1.94	10.11
2001	1.89	2.24	2.14	1.13	2.12	9.52
2002	1.91	1.94	2.08	1.21	1.75	8.88
2003	1.89	1.63	2.41	1.17	1.29	8.38
2004	1.62	1.59	2.32	0.99	1.90	8.42

Year	Other sources (emissions in tonnes)	Incineration and waste (emissions in tonnes)	Electric utilities (emissions in tonnes)	Iron and steel industries (emissions in tonnes)	Non-ferrous mining and smelting industry (emissions in tonnes)	Total (emissions in tonnes)
2005	1.42	1.43	2.17	0.79	1.70	7.51
2006	1.48	1.36	2.00	0.71	1.28	6.84
2007	1.44	1.67	2.18	0.89	1.42	7.60
2008	1.49	1.85	1.64	0.52	1.01	6.50
2009	1.32	1.44	1.67	0.45	0.84	5.73
2010	1.36	1.39	1.58	0.56	0.54	5.45
2011	1.32	1.43	1.02	0.58	0.21	4.56
2012	1.31	1.33	0.86	0.68	0.25	4.43
2013	1.34	1.30	0.85	0.70	0.36	4.55
2014	1.29	1.35	0.71	0.73	0.29	4.36
2015	1.35	1.34	0.74	0.72	0.18	4.33
2016	1.32	1.31	0.72	0.71	0.22	4.28

Note: Totals may not add up due to rounding. The indicator reports emissions from human activities only. The category "other sources" includes agriculture (livestock, crop production and fertilizer), building heating and energy generation, home firewood burning, manufacturing, the oil and gas industry, ore and mineral industries (except for the non-ferrous mining and smelting industry, and the iron and steel industries), transportation (road, rail, air and marine) and other miscellaneous sources. For more details on the sources, consult Table 1.
Source: Environment and Climate Change Canada (2018) Air Pollutant Emission Inventory.

- Table A.3. Data for

Figure 3. Mercury emissions to air by province and territory, Canada, 2006 and 2016

Province or territory	2006 (emissions in tonnes)	2016 (emissions in tonnes)
Newfoundland and Labrador	0.08	0.07
Prince Edward Island	0.02	0.02
Nova Scotia	0.25	0.14
New Brunswick	0.20	0.11
Quebec	0.88	0.79
Ontario	1.63	1.23

Province or territory	2006 (emissions in tonnes)	2016 (emissions in tonnes)
Manitoba	1.02	0.09
Saskatchewan	0.89	0.65
Alberta	1.27	0.60
British Columbia	0.59	0.57
Yukon	< 0.01	< 0.01
Northwest Territories	< 0.01	< 0.01
Nunavut	< 0.01	< 0.01
Canada	6.84	4.28

Note: Totals may not add up due to rounding. The indicator reports emissions from human activities only.
Source: Environment and Climate Change Canada (2018) Air Pollutant Emission Inventory.

Table A.4. Data for Figure 5. Global mercury emissions to air, 2010

Region	Mercury emissions (tonnes)	Percentage of global emissions
East and Southeast Asia	777.0	39.7
Sub-Saharan Africa	316.0	16.1
South America	245.0	12.5
South Asia	154.0	7.9
Commonwealth of Independent States (CIS) and other European countries	115.0	5.9
European Union (EU27)	87.5	4.5
North America	60.7	3.1
Central America and the Caribbean	47.2	2.4
Middle Eastern States	37.0	1.9
Australia, New Zealand & Oceania	22.3	1.1
North Africa	13.6	0.7
Undefined	82.0	4.2

Note: CIS = Commonwealth of Independent States. CIS includes Azerbaijan, Armenia, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russian Federation, Tajikistan, Turkmenistan, Uzbekistan and Ukraine. The Undefined region includes emissions from contaminated sites.

Source: United Nations Environmental Program, Chemicals Branch (2013) Global Mercury Assessment 2013: Sources, emissions, releases, and environmental transport.

Table A.5. Data for Figure 6. Lead emissions to air by source, Canada, 1990 to 2016

Year	Non-ferrous mining and smelting industry (emissions in tonnes)	Transportation (road, rail, air and marine) (emissions in tonnes)	Other sources (emissions in tonnes)	Iron and steel industries (emissions in tonnes)	Electric utilities (emissions in tonnes)	Mining and rock quarrying (emissions in tonnes)	Total (emissions in tonnes)
1990	886.23	78.95	60.13	53.89	11.27	198.61	1289.08
1991	847.45	60.11	59.90	53.89	11.46	207.68	1240.49
1992	899.20	54.25	58.18	53.89	12.00	204.79	1282.31
1993	476.08	54.03	56.60	53.89	11.27	188.57	840.43
1994	508.24	53.45	52.97	53.89	11.57	174.79	854.90
1995	630.69	59.59	36.67	48.50	11.91	134.02	921.38
1996	704.04	57.97	27.71	53.89	11.84	153.51	1008.96
1997	593.67	54.67	25.89	46.83	12.71	51.91	785.68
1998	527.37	56.43	23.38	45.50	13.66	18.20	684.53
1999	464.74	51.85	25.06	7.62	13.27	27.86	590.39
2000	464.51	52.10	24.36	3.52	14.04	12.18	570.72
2001	397.73	51.18	52.10	8.78	1.54	14.81	526.14
2002	371.27	50.47	28.38	8.54	1.81	10.55	471.01
2003	285.61	45.64	33.44	18.68	2.11	10.25	395.74
2004	230.79	41.75	27.43	16.59	1.97	11.87	330.39
2005	185.59	48.24	26.55	5.66	1.56	10.74	278.33
2006	224.44	43.17	24.57	5.88	3.23	10.43	311.73
2007	216.27	44.94	24.56	6.57	3.29	11.51	307.14
2008	193.60	43.62	26.32	5.99	2.78	10.78	283.08
2009	181.10	41.42	20.28	4.45	2.68	7.81	257.74
2010	140.80	37.53	22.59	6.28	2.18	10.04	219.42
2011	96.23	31.02	20.62	6.10	2.83	9.59	166.39
2012	88.35	37.79	14.40	6.68	2.55	6.92	156.69

Year	Non-ferrous mining and smelting industry (emissions in tonnes)	Transportation (road, rail, air and marine) (emissions in tonnes)	Other sources (emissions in tonnes)	Iron and steel industries (emissions in tonnes)	Electric utilities (emissions in tonnes)	Mining and rock quarrying (emissions in tonnes)	Total (emissions in tonnes)
2013	74.87	32.06	13.61	5.20	1.37	2.97	130.08
2014	85.47	27.81	15.34	6.11	1.78	0.73	137.24
2015	111.85	31.44	14.87	5.51	1.45	0.78	165.89
2016	111.65	32.85	16.11	5.21	1.41	0.94	168.16

Note: Totals may not add up due to rounding. The indicator reports emissions from human activities only. The category "other sources" includes agriculture (livestock, crop production and fertilizer), building heating and energy generation, home firewood burning, incineration and waste, manufacturing, the oil and gas industry, ore and mineral industries (except for the iron and steel industries, the non-ferrous mining and smelting industry, and mining and rock quarrying), paints and solvents and other miscellaneous sources. For more details on the sources, consult Table 1.
Source: Environment and Climate Change Canada (2018) Air Pollutant Emission Inventory.

Table A.6. Data for Figure 7. Lead emissions to air by province and territory, Canada, 2006 and 2016

Province or territory	2006 (emissions in tonnes)	2016 (emissions in tonnes)
Newfoundland and Labrador	1.07	3.00
Prince Edward Island	0.19	0.15
Nova Scotia	1.04	0.61
New Brunswick	16.12	12.36
Quebec	85.95	72.95
Ontario	104.05	54.44
Manitoba	67.87	3.96
Saskatchewan	2.62	2.94
Alberta	8.25	5.98
British Columbia	21.80	10.15
Yukon	0.69	0.54
Northwest Territories	1.66	0.93
Nunavut	0.42	0.16
Canada	311.73	168.16

Note: Totals may not add up due to rounding. The indicator reports emissions from human activities only.
Source: Environment and Climate Change Canada (2018) Air Pollutant Emission Inventory.

Table A.7. Data for Figure 9. Cadmium emissions to air by source, Canada, 1990 to 2016

Year	Non-ferrous mining and smelting industry (emissions in tonnes)	Other sources (emissions in tonnes)	Building heating and energy generation (emissions in tonnes)	Incineration and waste (emissions in tonnes)	Mining and rock quarrying (emissions in tonnes)	Total (emissions in tonnes)
1990	78.29	2.22	0.90	7.02	2.24	90.67
1991	67.85	2.25	0.90	6.33	4.40	81.73
1992	69.20	2.31	0.90	5.65	6.56	84.63
1993	11.95	2.38	0.92	4.97	0.32	20.54
1994	13.05	2.27	0.97	4.29	2.25	22.83
1995	17.30	2.44	1.02	3.61	4.43	28.80
1996	24.61	2.35	1.04	2.92	6.60	37.53
1997	41.03	2.28	1.03	2.24	0.34	46.93
1998	42.16	2.16	0.90	1.56	0.25	47.03
1999	36.64	2.37	0.94	0.88	0.33	41.16
2000	34.08	2.17	1.02	0.20	0.28	37.74
2001	65.22	2.31	0.99	0.17	0.19	68.88
2002	35.81	2.10	1.02	0.07	0.01	39.01
2003	27.02	2.95	1.05	0.06	0.13	31.22
2004	28.99	3.09	1.02	0.06	< 0.01	33.16
2005	31.14	2.47	0.99	0.06	0.36	35.01
2006	37.28	2.41	0.93	0.06	0.37	41.05
2007	24.83	2.64	1.01	0.06	0.37	28.91
2008	19.36	2.51	1.01	0.08	< 0.01	22.98
2009	17.37	2.67	0.96	0.05	0.28	21.33
2010	12.75	2.56	0.95	0.06	0.32	16.63
2011	4.79	2.62	1.02	0.05	0.29	8.76
2012	6.24	2.29	1.00	0.04	0.30	9.87

Year	Non-ferrous mining and smelting industry (emissions in tonnes)	Other sources (emissions in tonnes)	Building heating and energy generation (emissions in tonnes)	Incineration and waste (emissions in tonnes)	Mining and rock quarrying (emissions in tonnes)	Total (emissions in tonnes)
2013	5.33	2.10	0.96	0.05	0.29	8.73
2014	4.57	1.91	0.98	0.05	0.32	7.83
2015	5.06	1.72	0.94	0.05	0.02	7.78
2016	5.14	1.73	0.92	0.04	0.02	7.84

Note: Totals may not add up due to rounding. The indicator reports emissions from human activities only. The category "other sources" includes agriculture (livestock, crop production and fertilizer), electric utilities, home firewood burning, manufacturing, the oil and gas industry, ore and mineral industries (except for the non-ferrous mining and smelting industry, and mining and rock quarrying), paints and solvents, transportation (road, rail, air and marine) and other miscellaneous sources. For more details on the sources, consult Table 1.
Source: Environment and Climate Change Canada (2018) Air Pollutant Emission Inventory.

Table A.8. Data for Figure 10. Cadmium emissions to air by province and territory, Canada, 2006 and 2016

Province or territory	2006 (emissions in tonnes)	2016 (emissions in tonnes)
Newfoundland and Labrador	0.09	0.14
Prince Edward Island	0.01	0.01
Nova Scotia	0.14	0.06
New Brunswick	0.56	1.66
Quebec	2.84	1.71
Ontario	7.10	2.13
Manitoba	29.11	1.10
Saskatchewan	0.07	0.08
Alberta	0.52	0.48
British Columbia	0.59	0.44
Yukon	< 0.01	< 0.01
Northwest Territories	< 0.01	0.01
Nunavut	< 0.01	0.01
Canada	41.05	7.84

Note: Totals may not add up due to rounding. The indicator reports emissions from human activities only.
Source: Environment and Climate Change Canada (2018) Air Pollutant Emission Inventory.

Additional information can be obtained at:

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