# CANADA'S **BLACK CARBON INVENTORY** REPORT

2013–2024

2026

Environment and Climate Change Canada
Environnement et Changement climatique Canada

Canada

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# LIST OF COMMON ABBREVIATIONS AND UNITS

## Abbreviations

| | | |
|---|---|---|
| APEI | ..... | Air Pollutant Emissions Inventory |
| BC | ..... | black carbon |
| CLRTAP | ..... | Convention on Long-range Transboundary Air Pollution |
| ECCC | ..... | Environment and Climate Change Canada |
| EEA | ..... | European Environment Agency |
| EMEP | ..... | Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe or European Monitoring and Evaluation Programme |
| LTO | ..... | landing and takeoff |
| MOVES | ..... | MOtor Vehicle Emission Simulator |
| NFR | ..... | Nomenclature for Reporting |
| NPRI | ..... | National Pollutant Release Inventory |
| PM | ..... | particulate matter |
| $PM_{2.5}$ | ..... | particulate matter less than or equal to 2.5 microns in diameter |
| UNECE | ..... | United Nations Economic Commission for Europe |
| U.S. EPA | ..... | United States Environmental Protection Agency |

## Units

| | | |
|---|---|---|
| $kg/m^3$ | ..... | kilograms per cubic metre |
| kt | ..... | kilotonne |
| t | ..... | tonne |

# EXECUTIVE SUMMARY

Black carbon is a component of particulate matter (PM) and a short-lived climate pollutant. Specifically, it is a short-lived small aerosol (or airborne particle) linked to near-term climate warming, air pollution and adverse human health effects. Reducing black carbon emissions is of particular interest in polar regions, such as the Arctic, where it increases atmospheric warming and enhances melt when deposited on ice and snow.

In 2012, Parties to the Convention on Long-range Transboundary Air Pollution (CLRTAP) of the United Nations Economic Commission for Europe (UNECE) adopted amendments to its Gothenburg Protocol. The amendments added fine particulate matter to the Protocol and voluntary action, including emissions reporting of black carbon, as a component of fine particulate matter. In 2017, Canada ratified the Gothenburg Protocol and its 2012 amendments.

The Arctic Council was one of the first fora to recognize the importance of action on short-lived climate pollutants, in particular, black carbon, beginning in 2009. The Arctic Council Framework for Action on Enhanced Black Carbon and Methane Emissions Reductions was developed under Canada's most recent term as Chair of the Council (2013 to 2015) and was agreed upon in April 2015. It includes a commitment from all Arctic States to develop and improve emission inventories for black carbon using, where possible, relevant guidelines from the CLRTAP. In 2017, the eight Arctic States committed to the aspirational goal of reducing collective black carbon emissions by 25% to 33% relative to 2013 levels by 2025.

Canada's black carbon emissions inventory allows Canada to assess its progress in reducing black carbon emissions, combatting related climate change and human health issues, and to contribute to achieving the Arctic Council's collective aspirational goal. Canada's annual official submission to the UNECE comprises a black carbon dataset submitted by February 15 and its accompanied report by March 15, submitted along with the Air Pollutant Emissions Inventory.[1]

All emissions reported in this inventory are from anthropogenic sources. Natural sources of black carbon, such as wildfires, are not included. Emissions in this inventory, estimated at the national, provincial and territorial levels, are grouped according to the following source categories:[2]

- Ore and Mineral Industries
- Oil and Gas Industry
- Electric Power Generation (Utilities)
- Manufacturing
- Transportation and Mobile Equipment
- Agriculture
- Commercial/Residential/Institutional

In keeping with international reporting requirements, Canada's emissions of black carbon from aircraft at cruising altitude, as well as emissions from international marine navigation, are presented separately from other sources of emissions in this report and are excluded from Canada's national total emissions (see section A2.3 for more information).

This report presents the results of the 2026 edition of Canada's annual inventory of black carbon emissions, and includes information on the most recent estimates for 2013 to 2024.

### Black Carbon Emissions in 2024

In 2024, approximately 18 kilotonnes (kt) of black carbon were emitted in Canada (Table **ES-1**).[3]

Transportation and Mobile Equipment is the largest source of black carbon in Canada, accounting for 12 kt (66%) of total emissions in 2024. Of the various sources in this category, off-road diesel engines account for 7.0 kt (38%) of total emissions in 2024. The other large source in this category is diesel engines used for on-road transport, which account for 2.1 kt (12%) of total emissions.

[1] For more information on Canada's Air Pollutant Emissions Inventory, consult canada.ca/apei.
[2] Descriptions of sectors within the source categories can be found in Table A1–1.
[3] Throughout this report, data are presented as rounded figures. However, all calculations (including the ones to obtain percentages) have been performed using unrounded data.

Oil and Gas Industry is the second-largest source of black carbon emissions in Canada, accounting for 2.7 kt (15%) of total emissions in 2024. Within this category, Flaring and Incineration is the largest source, making up 1.4 kt (7.5%) of total emissions in 2024.

### Canada's Black Carbon Emissions Trends (2013–2024) and International Commitment

Since 2013, black carbon emissions in Canada have decreased overall by 12 kt (40%). Therefore, Canada has already achieved its share of the Arctic Council's goal to reduce black carbon emissions by 25-33% below 2013 levels by 2025.[4] Trends in black carbon emissions are largely driven by the Transportation and Mobile Equipment category and are consistent with observed trends in emissions of PM less than or equal to 2.5 microns in diameter ($PM_{2.5}$) (on which black carbon estimates are based) (Table **ES-1**).

When observing long-term emission trends, large-scale events can have a significant impact on a portion of the time series analyzed and should be considered. The years 2020 and 2021 were marked by the COVID-19 pandemic. This coincides with notable observed emission decreases between 2019 and 2020. Impacts of the pandemic, more pronounced in 2020, are now harder to distinguish in recent years, as black carbon emissions have resumed the gradual downward trend of recent years. More information on black carbon emissions and trends in Canada can be found in Chapter 2.

Irrespective of the downward trend, air quality issues may still arise when emission sources are spatially concentrated. While the black carbon inventory provides valuable information on emissions in Canada, it does not distinguish between localized sources of emissions within the provincial and territorial level aggregations. Work will continue to improve the completeness and accuracy of the inventory, quantifying the emissions that are not yet captured, and refining base data and estimation techniques. In line with the continuous improvement approach, emissions from the Landfill Gas sector, under the Electric Power Generation category, were added to the 2026inventory. In addition, a methodological improvement to the Home Firewood Burning sector was implemented, which resulted in downward recalculations in black carbon emissions compared to the 2025 edition. More information on estimation methods and recalculations can be found in Chapter 3.

[4] Recognizing that the Arctic Council goal to reduce black carbon is a collective goal, achievement of this goal for the Arctic Council writ large will require additional reductions from other Arctic States.

Table ES–1 **Canadian Black Carbon Emissions, Selected Years**

| Sector | Black Carbon (tonnes) | | | | | | Percentage of Total (%) |
|---|---|---|---|---|---|---|---|
| | 2013 | 2020 | 2021 | 2022 | 2023 | 2024 | |
| **ORE AND MINERAL INDUSTRIES** | **900** | **680** | **650** | **970** | **1 100** | **1 000** | **5.6** |
| Aluminium Industry | 65 | 42 | 42 | 38 | 42 | 46 | 0.3 |
| Cement and Concrete Industry | 19 | 16 | 21 | 23 | 26 | 20 | 0.1 |
| Iron and Steel Industry | 140 | 120 | 120 | 140 | 200 | 190 | 1.1 |
| Iron Ore Pelletizing | 1.2 | 1.1 | 1.0 | 0.97 | 0.82 | 0.86 | 0.0 |
| Mining and Rock Quarrying | 670 | 490 | 470 | 770 | 790 | 760 | 4.2 |
| Non-Ferrous Refining and Smelting Industry | 5.7 | 1.3 | 1.3 | 1.8 | 2.2 | 1.6 | 0.0 |
| **OIL AND GAS INDUSTRY** | **2 600** | **2 600** | **2 800** | **2 800** | **2 700** | **2 700** | **15** |
| Disposal and Waste Treatment | 0.12 | 0.07 | 0.06 | 0.07 | 0.08 | 0.07 | 0.0 |
| Flaring and Incineration | 1 400 | 1 300 | 1 400 | 1 400 | 1 400 | 1 400 | 7.5 |
| Heavy Crude Oil Cold Production | 93 | 88 | 88 | 89 | 89 | 89 | 0.5 |
| Light/Medium Crude Oil Production | 150 | 150 | 150 | 150 | 140 | 140 | 0.8 |
| Natural Gas Production and Processing | 530 | 500 | 500 | 500 | 500 | 500 | 2.7 |
| Natural Gas Transmission and Storage | 34 | 33 | 34 | 34 | 34 | 64 | 0.4 |
| Natural Gas Distribution | 0.82 | 0.47 | 0.54 | 0.61 | 0.65 | 0.64 | 0.0 |
| In Situ Thermal Extraction | 150 | 220 | 230 | 210 | 220 | 230 | 1.3 |
| Oil Sands Mining, Extraction and Upgrading | 200 | 280 | 340 | 380 | 300 | 280 | 1.5 |
| Petroleum Liquids Storage | 3.4 | 3.4 | 7.6 | 6.5 | 5.4 | 4.7 | 0.0 |
| Petroleum Liquids Transportation | 3.9 | 3.7 | 4.0 | 4.1 | 4.1 | 4.3 | 0.0 |
| Well Drilling/Servicing/Testing | 3.0 | 0.62 | 0.94 | 1.2 | 1.4 | 1.4 | 0.0 |
| **ELECTRIC POWER GENERATION (UTILITIES)** | **210** | **200** | **180** | **200** | **210** | **210** | **1.1** |
| Coal | 37 | 25 | 18 | 18 | 14 | 11 | 0.1 |
| Diesel | 130 | 140 | 120 | 140 | 150 | 160 | 0.9 |
| Landfill Gas | 6.0 | 3.7 | 2.7 | 2.7 | 2.7 | 2.1 | 0.0 |
| Natural Gas | 12 | 7.4 | 11 | 12 | 8.2 | 6.8 | 0.0 |
| Other (Electric Power Generation) | 25 | 28 | 25 | 27 | 31 | 27 | 0.2 |
| **MANUFACTURING** | **780** | **560** | **550** | **550** | **530** | **490** | **2.7** |
| Construction Fuel Combustion | 42 | 47 | 49 | 53 | 53 | 55 | 0.3 |
| Pulp and Paper Industry | 420 | 300 | 290 | 280 | 270 | 250 | 1.4 |
| Wood Products | 310 | 210 | 210 | 210 | 210 | 180 | 1.0 |
| **TRANSPORTATION AND MOBILE EQUIPMENT** | **24 000** | **15 000** | **14 000** | **13 000** | **13 000** | **12 000** | **66** |
| Air Transportation (LTO) | 230 | 140 | 160 | 170 | 180 | 170 | 1.0 |
| Domestic Marine Navigation, Fishing and Military | 810 | 480 | 330 | 350 | 360 | 380 | 2.1 |
| On-Road Transport | 7 500 | 3 000 | 3 000 | 2 800 | 2 800 | 2 800 | 15 |
| Diesel | 7 100 | 2 500 | 2 400 | 2 200 | 2 100 | 2 100 | 12 |
| Gasoline | 410 | 550 | 610 | 620 | 630 | 640 | 3.5 |
| Liquid Petroleum Gas | 0.51 | 0.36 | 0.41 | 0.40 | 0.39 | 0.36 | 0.0 |
| Natural Gas | 0.04 | 0.05 | 0.06 | 0.07 | 0.06 | 0.07 | 0.0 |
| Off-Road Transport | 14 000 | 10 000 | 9 700 | 9 100 | 8 400 | 7 600 | 42 |
| Diesel | 13 000 | 9 300 | 9 100 | 8 400 | 7 800 | 7 000 | 38 |
| Gasoline, Liquid Petroleum Gas and Natural Gas | 860 | 630 | 660 | 640 | 650 | 630 | 3.5 |
| Rail Transportation | 1 600 | 1 100 | 990 | 980 | 1 000 | 1 000 | 5.7 |
| **AGRICULTURE** | **46** | **36** | **32** | **25** | **22** | **19** | **0.1** |
| Agricultural Fuel Combustion | 46 | 36 | 32 | 25 | 22 | 19 | 0.1 |
| **COMMERCIAL/RESIDENTIAL/INSTITUTIONAL** | **2 100** | **2 000** | **1 800** | **2 000** | **1 800** | **1 800** | **9.7** |
| Commercial and Institutional Fuel Combustion | 830 | 1 000 | 940 | 1 000 | 950 | 920 | 5.1 |
| Home Firewood Burning | 1 100 | 830 | 750 | 790 | 730 | 690 | 3.8 |
| Fireplaces | 440 | 380 | 330 | 360 | 330 | 310 | 1.7 |
| Furnaces | 190 | 110 | 98 | 100 | 98 | 91 | 0.5 |
| Wood Stoves | 450 | 340 | 310 | 330 | 310 | 290 | 1.6 |
| Residential Fuel Combustion | 160 | 140 | 140 | 140 | 130 | 130 | 0.7 |
| Waste Incineration | 28 | 27 | 27 | 27 | 27 | 28 | 0.2 |
| **TOTAL** | **30 000** | **21 000** | **20 000** | **20 000** | **19 000** | **18 000** | **100** |

Notes:
Totals may not add up due to rounding.
Values in this report have been rounded to up to two significant digits.
0.00 Indicates emissions were truncated due to rounding.

**Other Emissions Estimated in the Black Carbon Inventory**

| Sector | Black Carbon (tonnes) | | | | | | Percentage of Total (%) |
|---|---|---|---|---|---|---|---|
| | 2013 | 2020 | 2021 | 2022 | 2023 | 2024 | |
| Domestic Air Transportation (Cruise) | 230 | 140 | 170 | 230 | 250 | 240 | 16 |
| International Air Transportation (Cruise) | 370 | 220 | 240 | 410 | 470 | 510 | 34 |
| International Marine Navigation | 1 100 | 760 | 720 | 780 | 710 | 730 | 49 |

Refer to Annex 2.3 for more information on Transportation and Mobile Equipment emissions reporting.

# INTRODUCTION

Black carbon is a short-lived small aerosol, or airborne particle, emitted by natural processes and human activities such as the incomplete combustion processes of fossil fuels, biofuels, and biomass. Black carbon has a lifetime of only a few days to a few weeks after its release in the atmosphere. Black carbon emissions have become a focus of attention due to their effects on the near-term warming of the atmosphere and on human health. Reducing black carbon emissions is of particular interest in polar regions, such as the Arctic, which are especially sensitive to the effects of black carbon. When suspended in air, black carbon turns solar radiation into heat, consequently contributing to air warming, regional cloud formation, and precipitation patterns. When black carbon particles settle on snow and ice, they darken the surface, reducing their albedo and enhancing absorption of solar radiation, thus indirectly increasing the rate of melting (U.S. EPA, 2011). Black carbon is not emitted on its own, but as a component of particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$), along with other components, such as organic carbon and inorganic compounds, such as sulphates.

The Arctic Council was one of the first fora to recognize the importance of taking action to address short-lived climate forcers and pollutants, such as black carbon, methane, and ground-level ozone. During Canada's term as Chair of the Arctic Council, from 2013 to 2015, the Council first promoted actions to achieve enhanced reductions of black carbon and methane emissions. The Framework for Action on Enhanced Black Carbon and Methane Emissions Reductions was agreed to in April 2015. A key component of this action is the voluntary reporting by Arctic states of their black carbon emissions to the United Nations Economic Commission for Europe (UNECE) in accordance with guidelines from the Convention on Long-range Transboundary Air Pollution (CLRTAP). At the Arctic Council ministerial meeting in 2017, Canada, along with other Arctic states, renewed its commitment to take action to reduce black carbon emissions. The Arctic Council states also committed to the aspirational goal of reducing collective black carbon emissions by 25% to 33% relative to 2013 levels by 2025. In line with this commitment, on November 28, 2017, Canada ratified the Gothenburg Protocol and its 2012 amendments under the CLRTAP. The amendments to the Gothenburg Protocol, which came into force in October 2019, included commitments to reduce emissions of $PM_{2.5}$ by 25% from 2005 levels before 2020 and beyond, and, in doing so, to prioritize sources of PM that are also significant sources of black carbon to provide benefits for human health and the environment and to help mitigation of near-term climate change. Canada's black carbon emissions annual inventory allows Canada to assess its progress in reducing black carbon emissions and combatting related climate change and human health issues and to contribute towards the Arctic Council's collective aspirational goal. Canada continues to improve the quality and transparency of information related to black carbon emissions and will continue to publish an annual black carbon inventory.

Canada's Black Carbon Inventory Report is an inventory of black carbon emissions at the national, provincial, and territorial levels. The report is prepared and published by Environment and Climate Change Canada (ECCC) and is compiled from many different data sources. It contributes to the tracking and quantifying of black carbon emissions. This document describes the 2026 edition of Canada's annual inventory of anthropogenic black carbon emissions, covering the years from 2013 to 2024. All emissions reported in this inventory are from anthropogenic (human) sources. Natural sources of black carbon, such as wildfires, are not included. Emissions are generally grouped in the same categories as those used in Canada's Air Pollutant Emissions Inventory (APEI). They are organized into seven source categories that are further broken down into 36 sectors and nine associated subsectors. See Annex 1 for source category organization and sector descriptions.

The estimates in this inventory are based on the best available information at the time of compilation. Estimates of $PM_{2.5}$ emissions are consistent with those reported in Canada's 2026 APEI. Please refer to Chapter 3 and Annex 2 of the APEI report (ECCC, 2026) for a description of the inventory development and estimation methods for $PM_{2.5}$. While the black carbon inventory provides valuable information on emissions in Canada, it does not distinguish localized sources of emissions within the provincial and territorial level aggregations. Work will continue to improve the quality, completeness, and accuracy of the inventory while quantifying the emissions that are not yet captured, and refining base data and estimation techniques. See Chapter 3 of the present report for more information on the black carbon inventory development.

## References

Environment and Climate Change Canada. (2026). *Canada's Air Pollutant Emissions Inventory Report 1990–2024.* https://www.canada.ca/en/environment-climate-change/services/pollutants/air-emissions-inventory-overview.html

United States Environmental Protection Agency. (2011). *Black carbon research and future strategies: Reducing emissions, improving human health, and taking action on climate change.* United States: Office of Research and Development. https://www.epa.gov/sites/default/files/2013-12/documents/black-carbon-fact-sheet_0.pdf

# BLACK CARBON EMISSIONS AND TRENDS IN CANADA

This chapter describes the main sources and sectors contributing to black carbon (BC) emissions and their trends since 2013. Emission sources have been grouped according to the following categories:

- Ore and Mineral Industries
- Oil and Gas Industry
- Electric Power Generation (Utilities)
- Manufacturing
- Transportation and Mobile Equipment
- Agriculture
- Commercial/Residential/Institutional

For each of these categories, emissions are further split into sectors as shown in Table **2-1**.[1] In keeping with international reporting requirements, Canada's emissions of black carbon from aircraft at cruising altitude, as well as emissions from international marine navigation, are presented separately from other emission sources in this report and are excluded from Canada's national total emissions (see Annex 2, section A2.3 for more information).

In 2024, black carbon emissions in Canada were 18 kt. Transportation and Mobile Equipment is the largest source of black carbon in Canada, accounting for 12 kt (66%), more than half of total emissions in 2024. Oil and Gas Industry is the next largest contributor, followed by the Commercial/Residential/Institutional category. An overview of the three most significant source categories and emission trends for their associated sectors can be found in sections 2.1 to 2.3. Section 2.4 covers the remaining sources, presented by order of magnitude of black carbon emissions. A summary of provincial and territorial estimates of black carbon emissions is provided in section 2.5.

Since 2013, black carbon emissions have decreased by 12 kt (40%) (Figure **2-1**). Trends in black carbon emissions are largely driven by the Transportation and Mobile Equipment category and are consistent with observed trends in emissions of particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$) (on which most of black carbon estimates are based). $PM_{2.5}$ emissions from combustion for all sources are available online on the Government of Canada Open Data website.[2]

When observing long-term emission trends, large-scale events can have a significant impact on a portion of the time series analyzed and should be considered. The years 2020 and 2021 were marked by the COVID-19 pandemic, coinciding with notable observed decreases in emissions between 2019 and 2020. Between 2021 and 2024, emissions decreased more gradually, while remaining considerably below 2019 pre-pandemic levels (-5.4 kt or -23%) in 2024. Impacts of the pandemic, more pronounced in 2020, are now harder to distinguish in recent years, as black carbon emissions have resumed the gradual downward trend of recent years.

Irrespective of the downward trends observed in Canadian emissions, air quality issues may still arise when emission sources are spatially concentrated. An overview of the methods used to develop the black carbon inventory, improvements applied to this edition of the inventory, sources of uncertainty and possible future refinements are described in Chapter 3.

[1] See Annex 1 for sector descriptions.
[2] https://open.canada.ca/data/en/dataset/d00dd235-d194-4932-9ec0-45011d2bd347

Table 2–1 **Canadian Black Carbon Emissions, Selected Years**

| Sector | Black Carbon (tonnes) | | | | | | Percentage of Total (%) |
|---|---|---|---|---|---|---|---|
| | 2013 | 2020 | 2021 | 2022 | 2023 | 2024 | |
| **ORE AND MINERAL INDUSTRIES** | **900** | **680** | **650** | **970** | **1 100** | **1 000** | **5.6** |
| Aluminium Industry | 65 | 42 | 42 | 38 | 42 | 46 | 0.3 |
| Cement and Concrete Industry | 19 | 16 | 21 | 23 | 26 | 20 | 0.1 |
| Iron and Steel Industry | 140 | 120 | 120 | 140 | 200 | 190 | 1.1 |
| Iron Ore Pelletizing | 1.2 | 1.1 | 1.0 | 0.97 | 0.82 | 0.86 | 0.0 |
| Mining and Rock Quarrying | 670 | 490 | 470 | 770 | 790 | 760 | 4.2 |
| Non-Ferrous Refining and Smelting Industry | 5.7 | 1.3 | 1.3 | 1.8 | 2.2 | 1.6 | 0.0 |
| **OIL AND GAS INDUSTRY** | **2 600** | **2 600** | **2 800** | **2 800** | **2 700** | **2 700** | **15** |
| Disposal and Waste Treatment | 0.12 | 0.07 | 0.06 | 0.07 | 0.08 | 0.07 | 0.0 |
| Flaring and Incineration | 1 400 | 1 300 | 1 400 | 1 400 | 1 400 | 1 400 | 7.5 |
| Heavy Crude Oil Cold Production | 93 | 88 | 88 | 89 | 89 | 89 | 0.5 |
| Light/Medium Crude Oil Production | 150 | 150 | 150 | 150 | 140 | 140 | 0.8 |
| Natural Gas Production and Processing | 530 | 500 | 500 | 500 | 500 | 500 | 2.7 |
| Natural Gas Transmission and Storage | 34 | 33 | 34 | 34 | 34 | 64 | 0.4 |
| Natural Gas Distribution | 0.82 | 0.47 | 0.54 | 0.61 | 0.65 | 0.64 | 0.0 |
| In Situ Thermal Extraction | 150 | 220 | 230 | 210 | 220 | 230 | 1.3 |
| Oil Sands Mining, Extraction and Upgrading | 200 | 280 | 340 | 380 | 300 | 280 | 1.5 |
| Petroleum Liquids Storage | 3.4 | 3.4 | 7.6 | 6.5 | 5.4 | 4.7 | 0.0 |
| Petroleum Liquids Transportation | 3.9 | 3.7 | 4.0 | 4.1 | 4.1 | 4.3 | 0.0 |
| Well Drilling/Servicing/Testing | 3.0 | 0.62 | 0.94 | 1.2 | 1.4 | 1.4 | 0.0 |
| **ELECTRIC POWER GENERATION (UTILITIES)** | **210** | **200** | **180** | **200** | **210** | **210** | **1.1** |
| Coal | 37 | 25 | 18 | 18 | 14 | 11 | 0.1 |
| Diesel | 130 | 140 | 120 | 140 | 150 | 160 | 0.9 |
| Landfill Gas | 6.0 | 3.7 | 2.7 | 2.7 | 2.7 | 2.1 | 0.0 |
| Natural Gas | 12 | 7.4 | 11 | 12 | 8.2 | 6.8 | 0.0 |
| Other (Electric Power Generation) | 25 | 28 | 25 | 27 | 31 | 27 | 0.2 |
| **MANUFACTURING** | **780** | **560** | **550** | **550** | **530** | **490** | **2.7** |
| Construction Fuel Combustion | 42 | 47 | 49 | 53 | 53 | 55 | 0.3 |
| Pulp and Paper Industry | 420 | 300 | 290 | 280 | 270 | 250 | 1.4 |
| Wood Products | 310 | 210 | 210 | 210 | 210 | 180 | 1.0 |
| **TRANSPORTATION AND MOBILE EQUIPMENT** | **24 000** | **15 000** | **14 000** | **13 000** | **13 000** | **12 000** | **66** |
| Air Transportation (LTO) | 230 | 140 | 160 | 170 | 180 | 170 | 1.0 |
| Domestic Marine Navigation, Fishing and Military | 810 | 480 | 330 | 350 | 360 | 380 | 2.1 |
| On-Road Transport | 7 500 | 3 000 | 3 000 | 2 800 | 2 800 | 2 800 | 15 |
| Diesel | 7 100 | 2 500 | 2 400 | 2 200 | 2 100 | 2 100 | 12 |
| Gasoline | 410 | 550 | 610 | 620 | 630 | 640 | 3.5 |
| Liquid Petroleum Gas | 0.51 | 0.36 | 0.41 | 0.40 | 0.39 | 0.36 | 0.0 |
| Natural Gas | 0.04 | 0.05 | 0.06 | 0.07 | 0.06 | 0.07 | 0.0 |
| Off-Road Transport | 14 000 | 10 000 | 9 700 | 9 100 | 8 400 | 7 600 | 42 |
| Diesel | 13 000 | 9 300 | 9 100 | 8 400 | 7 800 | 7 000 | 38 |
| Gasoline, Liquid Petroleum Gas and Natural Gas | 860 | 630 | 660 | 640 | 650 | 630 | 3.5 |
| Rail Transportation | 1 600 | 1 100 | 990 | 980 | 1 000 | 1 000 | 5.7 |
| **AGRICULTURE** | **46** | **36** | **32** | **25** | **22** | **19** | **0.1** |
| Agricultural Fuel Combustion | 46 | 36 | 32 | 25 | 22 | 19 | 0.1 |
| **COMMERCIAL/RESIDENTIAL/INSTITUTIONAL** | **2 100** | **2 000** | **1 800** | **2 000** | **1 800** | **1 800** | **9.7** |
| Commercial and Institutional Fuel Combustion | 830 | 1 000 | 940 | 1 000 | 950 | 920 | 5.1 |
| Home Firewood Burning | 1 100 | 830 | 750 | 790 | 730 | 690 | 3.8 |
| Fireplaces | 440 | 380 | 330 | 360 | 330 | 310 | 1.7 |
| Furnaces | 190 | 110 | 98 | 100 | 98 | 91 | 0.5 |
| Wood Stoves | 450 | 340 | 310 | 330 | 310 | 290 | 1.6 |
| Residential Fuel Combustion | 160 | 140 | 140 | 140 | 130 | 130 | 0.7 |
| Waste Incineration | 28 | 27 | 27 | 27 | 27 | 28 | 0.2 |
| **TOTAL** | **30 000** | **21 000** | **20 000** | **20 000** | **19 000** | **18 000** | **100** |

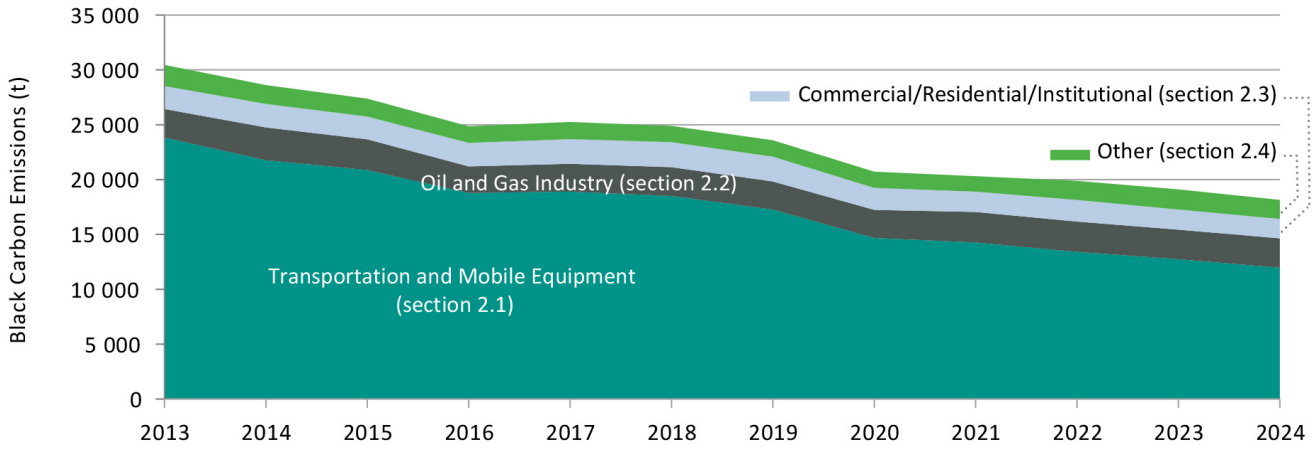
Notes:
Totals may not add up due to rounding.
Values in this report have been rounded to up to two significant digits.
0.00 Indicates emissions were truncated due to rounding.

**Other Emissions Estimated in the Black Carbon Inventory**

| Sector | Black Carbon (tonnes) | | | | | | Percentage of Total (%) |
|---|---|---|---|---|---|---|---|
| | 2013 | 2020 | 2021 | 2022 | 2023 | 2024 | |
| Domestic Air Transportation (Cruise) | 230 | 140 | 170 | 230 | 250 | 240 | 16 |
| International Air Transportation (Cruise) | 370 | 220 | 240 | 410 | 470 | 510 | 34 |
| International Marine Navigation | 1 100 | 760 | 720 | 780 | 710 | 730 | 49 |

Refer to Annex 2.3 for more information on Transportation and Mobile Equipment emissions reporting.

**Figure 2-1: Trends in Canadian Black Carbon Emissions (2013 to 2024)**



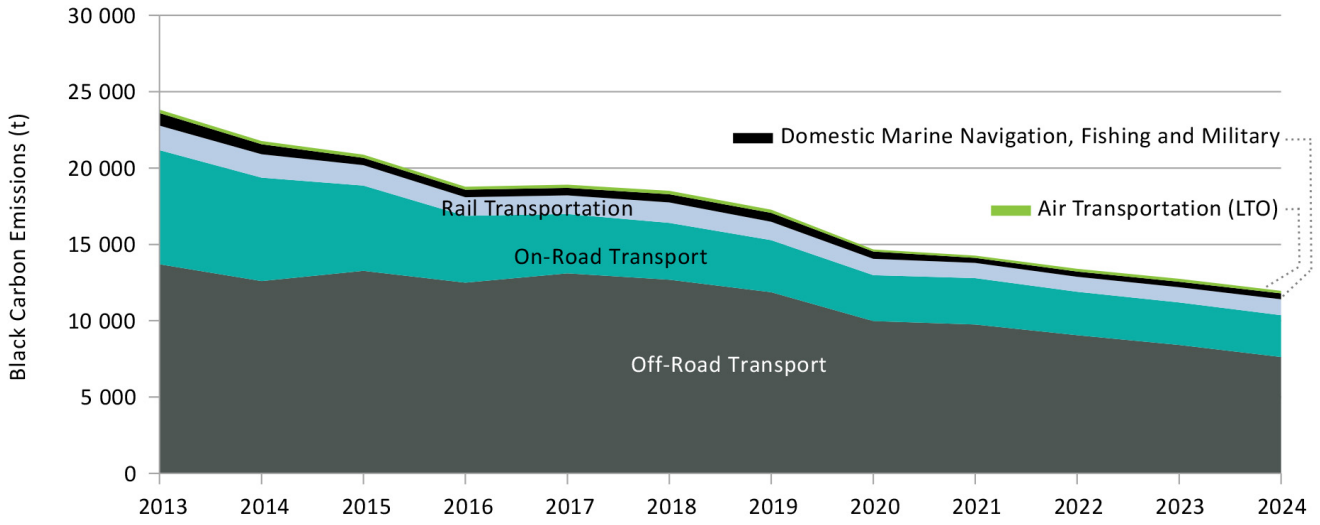

## 2.1 Transportation and Mobile Equipment

Transportation and Mobile Equipment includes black carbon emissions from air, marine, rail, on- and off-road transportation (Figure **2-2**). Off-Road Transport is a highly diverse sector that includes lawn and garden equipment; recreational vehicles (e.g., pleasure craft and snowmobiles); farm, construction and mining equipment; and portable generators and pumps. Both on-road and off-road diesel engines are subject to emission standards for PM and are equipped with sophisticated emission controls to reduce PM emissions. As more engines within Canada's vehicle population are equipped with this technology, PM emission rates are expected to decrease, which in turn will reduce black carbon emissions.

The Transportation and Mobile Equipment category is the largest source of anthropogenic black carbon from combustion in Canada, accounting for 12 kt (66%) of total emissions in 2024 (Table **2-1**). Of the various sources in this category, off-road diesel engines account for most of these emissions, with 7.0 kt (38%) of total emissions in 2024. The second-largest source in this category is diesel engines used for on-road transport, which account for 2.1 kt (12%) of total emissions.

On-road and off-road diesel engines emit significant quantities of $PM_{2.5}$ and have the highest $BC/PM_{2.5}$ ratios of all black carbon sources. As a result, mobile diesel engines account for nearly all emissions from this category, and 50% of total black carbon emissions in 2024. The implementation of effective fuel and engine regulations for on-road and off-road diesel, in addition to reduced on-road diesel fuel consumption, resulted in decreases to on-road and off-road diesel emissions between 2013 and 2024 by 70% (5.0 kt) and 46% (5.9 kt) respectively, contributing to a 54% decrease overall. The remaining black carbon emissions from Transportation and Mobile Equipment come from air, marine, non-diesel on- and off-road transport, and rail transportation, which accounted for 2.9 kt (16%) of the total black carbon emitted in 2024. Among these sectors, the most significant is rail transportation, which accounted for 1.0 kt (5.7%) of total black carbon emissions in 2024.

**Figure 2-2: Trends in Canadian Black Carbon Emissions from Transportation and Mobile Equipment (2013 to 2024)**



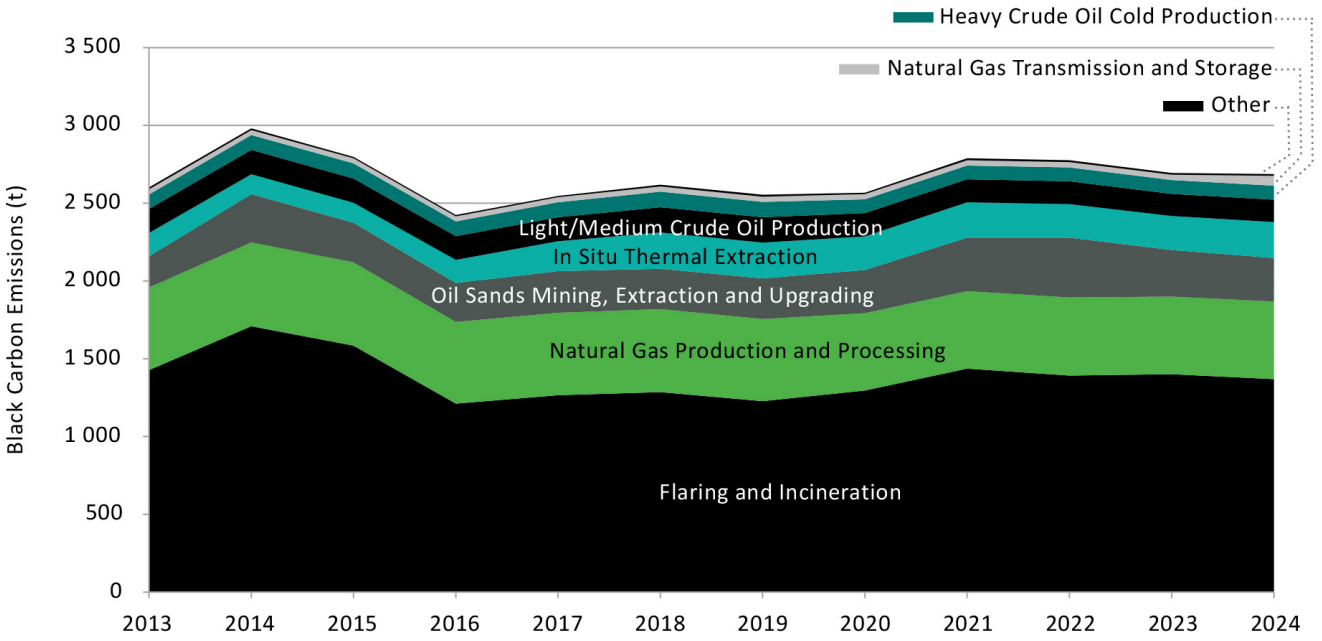

## 2.2 Oil and Gas Industry

The Oil and Gas Industry accounted for 2.7 kt (15%) of all black carbon emitted in 2024. The main sources of black carbon emissions in the Oil and Gas Industry include fuel combustion to power pumps, engines and heaters and natural gas flaring (Figure **2-3**). Black carbon emissions from fuel combustion are broken down by 12 sectors. While flaring occurs in most oil and gas sectors, it is presented separately since it is a significant source of black carbon emissions.

Since 2013, black carbon emissions from the Oil and Gas industry have increased slightly, by 0.09 kt (3.3%). Of all Oil and Gas sectors included in this inventory, Flaring and Incineration accounted for the largest proportion (1.4 kt or 7.5%) of total black carbon emissions in 2024 (Figure **2-3**). Emissions from this sector decreased by 0.06 kt (4.1%) between 2013 and 2024. Emissions from flaring are directly related to volumes of gas flared in the industry and vary from year to year due to a variety of factors. For example, federal and provincial regulations came into force in 2020 to reduce methane emissions from the oil and gas industry. Since methane is a potent greenhouse gas, flaring is preferred to venting as it reduces emissions of methane and non-methane volatile organic compounds by converting them to carbon dioxide through combustion. It does, however, increase emissions of black carbon as well as carbon monoxide, $PM_{2.5}$, and nitrogen oxides. In response to the regulations, the volume of gas flared increased between 2019 and 2024, resulting in a 12% increase in black carbon emissions from flaring over the same period.

The next two largest sources of black carbon emissions in this category are Natural Gas Production and Processing, which accounted for 0.50 kt (2.7%) of total black carbon emissions, and Oil Sands Mining, Extraction and Upgrading, which accounted for 0.28 kt (1.5%) of total black carbon emissions. Natural Gas Production and Processing emissions remained relatively stable between 2013 and 2024. Since 2013, black carbon emissions from Oil Sands Mining, Extraction and Upgrading and from In Situ Thermal Extraction have increased by a combined total of 0.16 kt (46%). This is consistent with a 76% increase in crude bitumen production from mining operations and a 93% increase in crude bitumen production from in situ thermal extraction facilities, both of which contribute to increased fuel combustion and flaring activities.

**Figure 2-3: Trends in Canadian Black Carbon Emissions from the Oil and Gas Industry (2013 to 2024)**

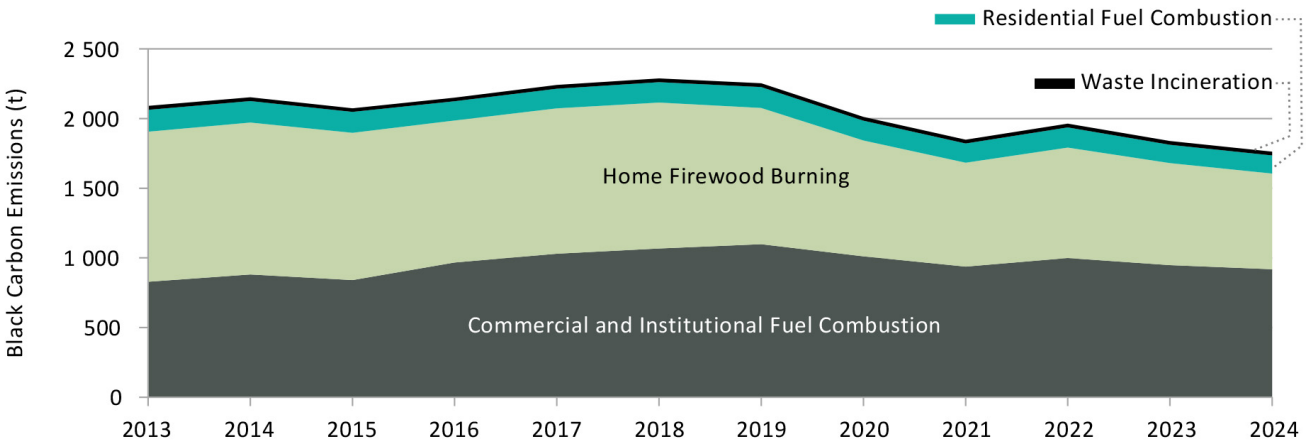



## 2.3 Commercial/Residential/Institutional Sources

Commercial/Residential/Institutional sources include four sectors. Most emissions from these sources are due to combustion in large, relatively efficient commercial boilers, or in small, less-efficient residential fireplaces and wood stoves. In 2024, Commercial/Residential/Institutional sources accounted for 1.8 kt (9.7%) of total emissions. Of these sources, Commercial and Institutional Fuel Combustion accounted for the largest proportion (0.92 kt or 5.1%) of total black carbon emissions in 2024 (Figure **2-4**). Between 2013 and 2024, emissions from this sector have increased 0.09 kt (11%), due to the increase in natural gas consumption in this sector.

The remainder of this category accounted for 0.84 kt (4.6%) of total black carbon emissions in 2024. Home Firewood Burning accounted for 0.69 kt (3.8%) of total emissions, making it the second-largest source of black carbon emissions in this category. The decreasing trend in this sector between 2013 and 2024 (0.39 kt or 36%) can be attributed in part to the reduction in the use of conventional fireplaces and wood stoves and their replacement with fireplace inserts, furnaces and stoves with improved emission controls and combustion efficiencies. It can also be attributed in part to 2024 having a warmer heating season, as indicated by a 20% decrease in heating degree-days and thus, a reduced quantity of wood burned.

**Figure 2-4: Trends in Canadian Black Carbon Emissions from Commercial/Residential/Institutional Sources (2013 to 2024)**



## 2.4 Other sources

In this section, emission trends for all remaining sources are presented by order of magnitude. This includes Ore and Mineral Industries, Manufacturing, Electric Power Generation (Utilities) and Agriculture (Figure **2-5**).

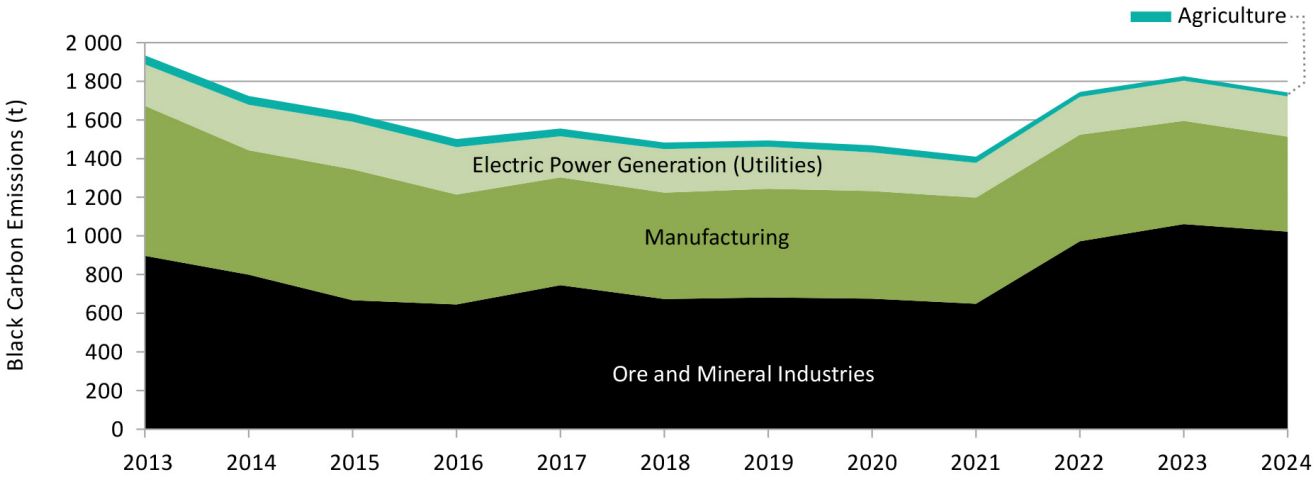
Ore and Mineral Industries sources, which include primary resource extraction and processing, accounted for 1.0 kt (5.6%) of total black carbon emissions in 2024. The largest emitter of black carbon in this category is the Mining and Rock Quarrying sector (0.76 kt or 4.2% of total emissions). Between 2013 and 2024, emissions from Ore and Minerals Industries have increased (0.12 kt or 14%). The main contributor to the trend is the mining sector, mainly due to increases in combustion emissions reported to the National Pollutant Release Inventory (NPRI) for this sector, as well as the use of diesel fuel to generate electricity at remote mines in northern areas.

Manufacturing sources include three sectors and account for 0.49 kt (2.7%) of total black carbon emissions in 2024. The decreasing trend in this source category between 2013 and 2024 (0.28 kt or 37%) is largely consistent with reduced production in both the Pulp and Paper Industry and Wood Products sectors.

Electric Power Generation (Utilities) sources include the combustion of coal, diesel, landfill gas, natural gas and other fuels for the purpose of generating electricity. Electric Power Generation (Utilities) accounted for 0.21 kt (1.1%) of all black carbon emissions in 2024, with a 2.8% decrease in emissions since 2013. Large facilities using solid fuels are equipped with particulate controls, while boilers and heaters using liquid and gaseous fuels emit limited particulate matter. There is relatively little diesel fuel used in large stationary electricity generation applications.

Agriculture sources consist of fuel use for non-mobile equipment (e.g., for drying grain, heating barns) and accounted for 0.02 kt (0.1%) of total black carbon emitted in 2024. The decrease in black carbon emissions between 2013 and 2024 (0.03 kt or 58%) is largely a result of reduced coal consumption in non-mobile equipment in Alberta.

**Figure 2-5: Trends in Canadian Black Carbon Emissions from Other Sources (2013 to 2024)**

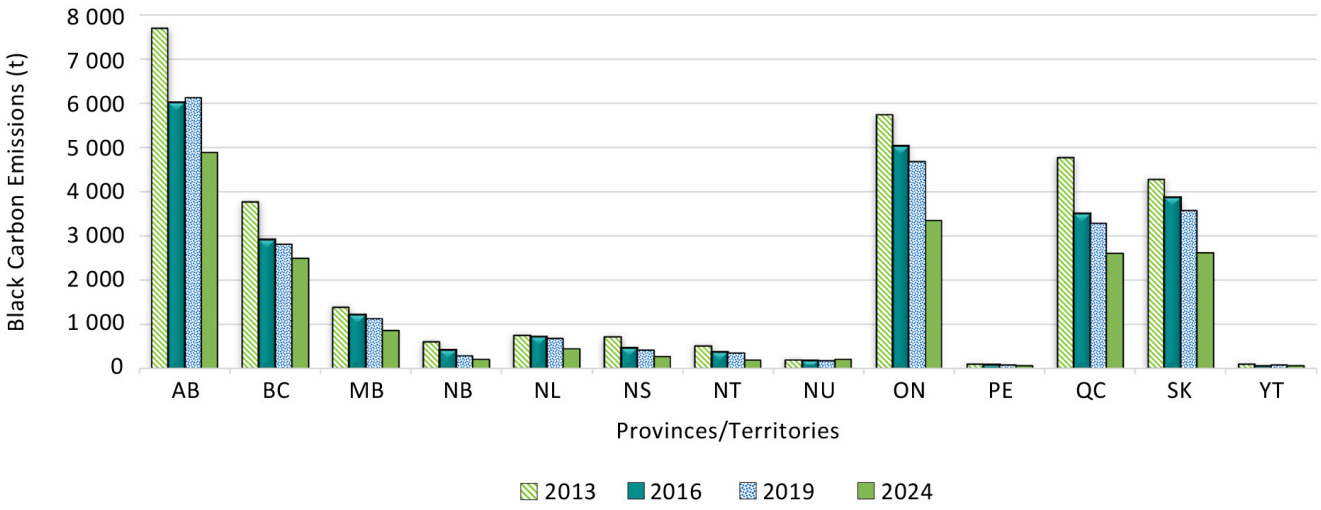


## 2.5 Provincial and Territorial Black Carbon Emissions Trends

Since 2013, black carbon emission trends in Canadian provinces and territories are consistent with the national trend, with decreasing emissions (Figure **2-1** and Figure **2-6**). The most significant decreases in total emissions between 2013 and 2024 occurred in Alberta (2.8 kt or 36%), Ontario (2.4 kt or 41%) and Quebec (2.2 kt or 46%). By percentage, the decrease is most notable for New Brunswick (68%).

The full-time series of national, provincial, and territorial black carbon emissions from 2013 to 2024 are available online on the Government of Canada Open Data website.[3]

**Figure 2-6: Trends in Black Carbon Emissions from Canadian Provinces and Territories**




[3] https://open.canada.ca/data/en/dataset/d00dd235-d194-4932-9ec0-45011d2bd347

# INVENTORY DEVELOPMENT

The Black Carbon (BC) Inventory is based on the Air Pollutant Emissions Inventory (APEI) (ECCC, 2026). This chapter gives an overview of the development of the Black Carbon Inventory. For more details on the APEI development, refer to Chapter 3 of the APEI Report (ECCC, 2026).

## 3.1 Overview of Methodology to Calculate Black Carbon Emissions

Two important assumptions underlie the present inventory: black carbon is predominantly emitted in particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$), and only $PM_{2.5}$ emissions resulting from combustion contain significant amounts of black carbon. Therefore, for sources where BC emissions are not directly calculated, emissions are based on the $PM_{2.5}$ emitted from combustion processes and multiplied by the BC/$PM_{2.5}$ fractions specific to each type of source. Although non-combustion sources, such as dust raised by traffic on paved and unpaved roads or by wind, and machinery on open fields or mine sites, are significant sources of $PM_{2.5}$, they are not considered sources of black carbon in this inventory.

For example, diesel engines have relatively high emission rates of $PM_{2.5}$ per unit energy, and the fraction of black carbon in these $PM_{2.5}$ emissions is also relatively high. The majority of diesel fuel in Canada is used for mobile sources, including off-road applications. Other combustion sources with high $PM_{2.5}$ emissions include solid fuel combustion units, such as coal- and wood-fired boilers and wood fireplaces. Industrial sources are generally equipped with $PM_{2.5}$ controls on boiler emissions, with PM-control efficiencies often in the 90% range. This is reflected in their lower $PM_{2.5}$ emissions compared to other sources. In contrast, the smaller and markedly different equipment used for residential wood combustion (fireplaces, wood stoves or furnaces) have poorer control efficiencies than larger units, notwithstanding the different types of fuel and firing practices used for burning firewood. Given their lower efficiency, combined with the lack of treatment of stack gases for many existing residential wood-burning devices, such devices are the largest source of combustion-related $PM_{2.5}$ emissions from the residential sector in Canada.

The dataset that breaks down the $PM_{2.5}$ emitted from a particular source (e.g., diesel engine emissions) into its different components, including black carbon and organic carbon, is known as a speciation profile. Most speciation profiles contain a fraction for elemental carbon; these fractions are commonly used as a surrogate to quantify black carbon emissions. The current inventory relies primarily on the United States Environmental Protection Agency's (U.S. EPA) SPECIATE database (U.S. EPA, 2022) to calculate black carbon emissions from compiled combustion $PM_{2.5}$ emissions. Several $PM_{2.5}$ speciation profiles are specific to the combustion processes or technologies (e.g., lime kilns in the pulp and paper industry), to the subsector classification (e.g., concrete batching and products), to the fuel type (e.g., diesel, gasoline, natural gas) or to the application (e.g., natural gas use for electrical power generation).

Where readily available, the $PM_{2.5}$ emissions data from combustion are used directly with BC/$PM_{2.5}$ fractions to estimate black carbon emissions. All BC/$PM_{2.5}$ fractions used in this inventory are available online on the Government of Canada Open Data website.[1] For example, estimates for Agricultural Fuel Combustion sources are based on the fuel type and quantity consumed in Canada, and the corresponding BC/$PM_{2.5}$ fraction.

Some activity data does not specify whether $PM_{2.5}$ is derived from combustion or non-combustion sources. In these cases, separating combustion from non-combustion sources of $PM_{2.5}$ remains a challenge because of a lack of data on activities (i.e., quantity of fuel burned) or on contributions from non-combustion sources (e.g., rock dust at a mine). In those cases, separating combustion $PM_{2.5}$ from non-combustion $PM_{2.5}$ is done based on expert knowledge of the relevant activities prior to applying BC/$PM_{2.5}$ fractions. For example, National Pollutant Release Inventory (NPRI) facility-reported data of $PM_{2.5}$ releases from stacks form the basis of black carbon estimates. For each individual stack, the appropriate black carbon speciation factor (or factors) is applied to the combustion-related $PM_{2.5}$. The emissions are then summed at the facility level and aggregated to form the sectoral emission estimates.

For sources of $PM_{2.5}$ that are not covered by NPRI reporting requirements, their $PM_{2.5}$ emissions are calculated using activity data (i.e., statistics datasets) and emission factors. For this inventory, emissions from Manufacturing, Electric Power Generation as well as Ore and Mineral Industries are estimated using facility data. Oil and Gas Industry estimates are based on facility-reported data used in combination with the results of independent studies (EC, 2014; ECCC, 2017; Quadram Engineering Ltd, 2019).

[1] https://data-donnees.az.ec.gc.ca/data/substances/monitor/canada-s-black-carbon-inventory/

Other notable methodologies that are used to estimate black carbon emissions at the sector level include:

- In some upstream oil and gas subsectors, black carbon emissions from flaring are directly calculated using the volume of flared gas, the higher heating value (HHV) of the gas, and an empirical equation relating the HHV to black carbon emissions (Quadram Engineering Ltd, 2019).
- To estimate emissions from mobile sources, bottom-up approaches are adopted, i.e., applying fuel-specific emission factors to disaggregated activity data, such as vehicle or equipment data sorted by class, age or model year.
    - In most cases, $PM_{2.5}$ is estimated first, and BC/$PM_{2.5}$ fractions are subsequently applied. For Road Transportation, elemental carbon (as a proxy for BC) is taken directly from the MOtor Vehicle Emission Simulator (MOVES) model output.
    - The methods for estimating $PM_{2.5}$ emissions from mobile sources are described in the APEI Report (ECCC, 2026).
- Home Firewood Burning black carbon emissions are estimated using black carbon emission factors developed to represent Canadian conditions in terms of appliance type and wood species. The emission factors are applied directly to fuel consumption data, avoiding the necessity of using a BC/$PM_{2.5}$ ratio.
    - A 2017 study (Kindbom, 2017) concluded that emission factors of elemental carbon (which represents BC) from residential wood stoves do not correlate with $PM_{2.5}$ emission factors.
    - The method is based on directly measured results from Environment and Climate Change Canada's (ECCC) report on residential wood combustion (2025), which summarizes findings from two studies conducted by PFS TECO and Université de Sherbrooke (available upon request).
- Black carbon emissions due to agricultural, construction and residential fuel combustion (excluding wood) are estimated by calculating $PM_{2.5}$ emissions from fuel consumption data and subsequently applying appropriate black carbon speciation profiles.
- Commercial Fuel Combustion uses a combination of facility-reported and fuel consumption data, applying appropriate emission factors to estimate $PM_{2.5}$ emissions and then applying appropriate speciation profiles.
- Waste Incineration emissions are estimated using a combination of facility-reported data and data from facility surveys.

## 3.2 Recalculations

As new data and methodologies become available, emission estimates from previous inventory editions are recalculated to provide a consistent and comparable trend in emissions. Recalculations occur annually for numerous reasons, including the following:

- correction of errors detected by quality control procedures
- incorporation of updates to activity data including changes to data sources
- reallocation of activities to different categories (which affects subtotals)
- refinements of methodologies, BC/$PM_{2.5}$ fractions and emission factors
- inclusion of categories previously not estimated (which improves inventory completeness)

Table 3-1 presents the main improvements and updates to the estimation methodologies for this year's inventory.

Total emissions for black carbon and $PM_{2.5}$ were revised for all years as presented in Figure **3-1** and Figure **3-2**. Overall, recalculations of previously reported 2013–2023 estimates resulted in a downward revision in black carbon emissions between -12% and -17% (between -2.5 kt and -5.0 kt), and for $PM_{2.5}$ emissions, the revision ranged from -0.1% to +1.1% (between -0.18 kt and +1.2 kt). The trends between 2013 and 2023 remained relatively comparable for the previous and current submission. Black carbon emissions decreased by approximately 39% and $PM_{2.5}$ emissions, by around 30% between 2013 and 2023. The difference between the black carbon and $PM_{2.5}$ emission trends is, as mentioned above, due to some sectors not using $PM_{2.5}$ to estimate emissions.

**Table 3-1 : Summary of Methodological Changes, Refinements or Improvements**

| DESCRIPTION | IMPACT ON EMISSIONS |
|---|---|
| **Oil and Gas Industry** | |
| Minor recalculations to flaring and fuel combustion emissions from the oil and gas industry occurred for all years from 2013 to 2023. These recalculations resulted from methodological updates to British Columbia flaring estimates and a combination of updates to activity data and facility-reported $PM_{2.5}$ emissions. | Recalculations resulted in upward revisions to emissions for the Oil and Gas Industry from 2013 to 2023, with a maximum increase of 157 tonnes (6.2%) in 2023. |
| **Electric Power Generation (Utilities)** | |
| Improvement to the Electric Power Generation sector occurred with the addition of the combustion of landfill gas for energy purposes. | This improvement resulted in minor upward changes to emissions in the Electric Power Generation industry from 2013 to 2023, with a maximum increase of 6.8 tonnes in 2014. |
| **Transportation and Mobile Equipment** | |
| Recalculations occurred primarily due to updates to activity data and updates to the off-road emissions model NONROAD. | Recalculations resulted in upward revisions to emissions for the Oil and Gas Industry from 2013 to 2023, with a maximum increase of 157 tonnes (6.2%) in 2023. Recalculations resulted in upward revisions to emissions for Transportation and Mobile Equipment from 2013 to 2023, with a maximum increase of 649 tonnes (5.4%) in 2023. |
| **Commercial/Residential/Institutional Sources** | |
| Recalculations occurred due to new black carbon emission factors in Home Firewood Burning. The downward revision is a result of using black carbon emission factors representative of the appliance inventory in Canada over the time series rather than a single ratio applied across all appliances and years. | The Home Firewood Burning recalculations resulted in a maximum downward revision of 5.7 kt (84%) in 2014. |

**Figure 3-1: Comparison of Black Carbon Emission Trends (2026 vs 2025 Inventory Edition)**

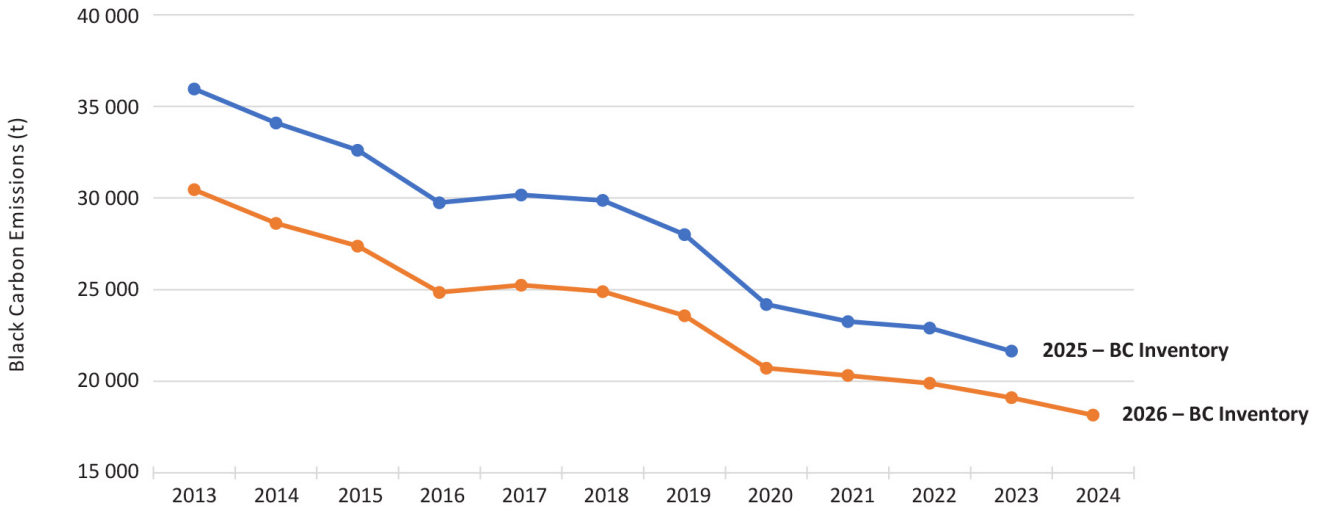
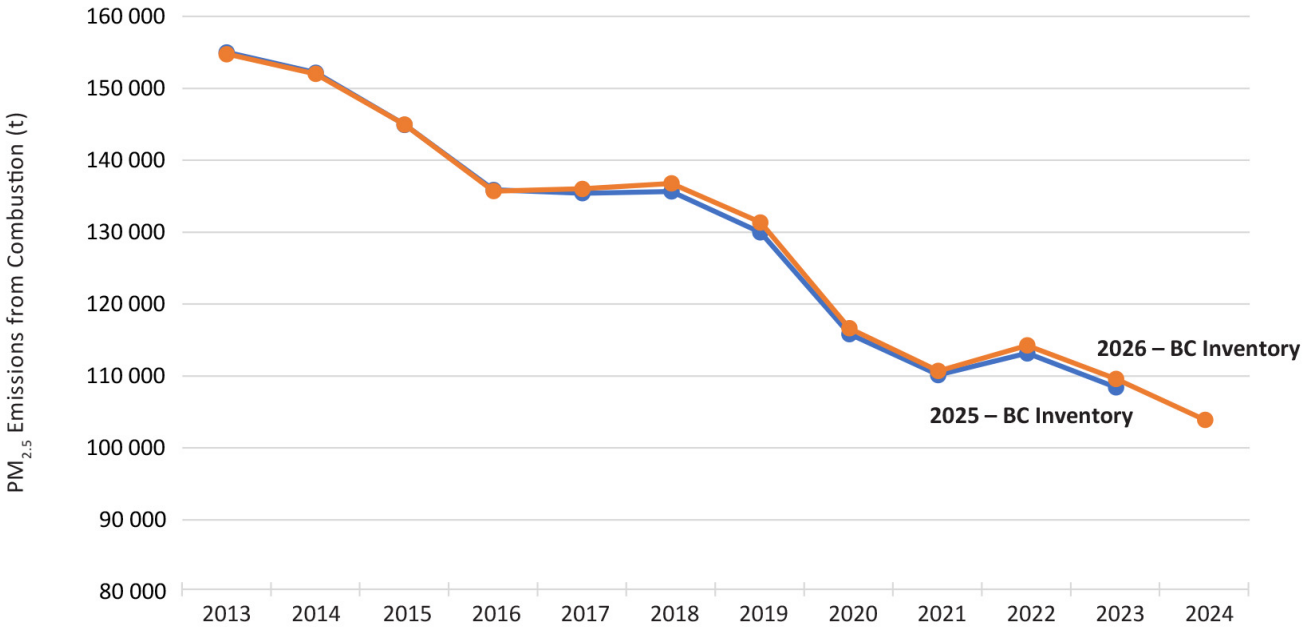


**Figure 3-2: Comparison of $PM_{2.5}$ from Combustion Emission Trends (2026 vs 2025 Inventory Edition)**




## 3.3 Sources of Uncertainty

A key source of uncertainty associated with black carbon inventories is inconsistency between definitions and measurements of black carbon (Bond et al., 2013). Scientists use different methods to measure black carbon particle emissions at the source and in the atmosphere, and therefore measured quantities are not strictly comparable.

Although not quantified, uncertainty in the black carbon estimates in this inventory stems partly from the uncertainty around the BC/$PM_{2.5}$ fractions. There is large variability in the size of measurement samples used to derive these fractions; the same fractions can by default be applied to several different technologies. An example of the limitation of available BC/$PM_{2.5}$ fractions can be seen with the application of the diesel BC/$PM_{2.5}$ fraction for aviation turbo fuel in jet aircraft, as there is no available fraction specific to aviation turbo fuel. The refinement of BC/$PM_{2.5}$ fractions is dependent on new measurements. Assignment of fractions to sector or equipment type is made using engineering knowledge and judgment based on limited available information (such as facility stack information), with varying degrees of accuracy. Alternatively, to reduce uncertainty, emission factors can replace some BC/$PM_{2.5}$ fractions as they become available.

There is considerable uncertainty in determining the proportion of combustion $PM_{2.5}$ emissions from industrial sources. The primary data source for estimating $PM_{2.5}$ emissions from many industrial sources is the NPRI, in which emissions are reported by facilities by stack or as one aggregate value for the facility as a whole and are mostly not broken down between combustion and non-combustion emissions.

## 3.4 Considerations for Future Editions of this Inventory

Future improvements will focus on expanding current coverage, as well as improving the accuracy of emission estimates. Possible examples include the following:

- Explore incorporating emissions from diesel engines used for electricity generation in remote locations that are not currently reporting emissions to the NPRI.
- Review and update the BC/$PM_{2.5}$ fractions for off-road transportation.
- Review and update the BC emission factors for marine transportation.
- Include emissions from prescribed burning, which is the controlled and intentional burning of biomass as a land management practice.
- Review and update the BC/$PM_{2.5}$ fractions used for construction, commercial and institutional natural gas combustion.

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# SECTOR DESCRIPTIONS

The sectors, and their descriptions, for which black carbon emission estimates have been calculated are listed in Table **A1-1**.

**Table A1-1 : Summary of Black Carbon Inventory Sector Descriptions**

| | |
|---|---|
| **ORE AND MINERAL INDUSTRIES** | |
| **Aluminium Industry** | Alumina production through bauxite refining, primary aluminium production through coke calcination, anode paste production, anode baking, potroom electrolysis and casting, and secondary aluminium production in which aluminium is recovered from aluminium-containing scrap. |
| **Cement and Concrete Industry** | Entire process of cement production in rotary kilns, as well as the preparation of concrete and ready-mix concrete, lime manufacture, concrete batching and products, and gypsum product manufacture. |
| **Iron and Steel Industry** | Coke production, iron production, including blast furnaces and direct reduced iron, and steel production including basic oxygen furnaces, electric arc furnaces, sintering, hot forming and semi-finishing. |
| **Iron Ore Pelletizing** | The process includes grinding, drying, balling, and thermal treatment of iron-containing raw materials (i.e., fine iron ore and additives). |
| **Mining and Rock Quarrying** | Overburden removal, drilling in rock, blasting, crushing of rock, loading of materials, transporting raw materials by conveyors, scraping, bulldozing, grading, open storage pile losses and wind erosion from exposed areas. |
| **Non-Ferrous Refining and Smelting Industry** | Primary copper and nickel production using pyrometallurgical operations, lead ore crushing, concentrating and metallurgic processing and zinc metal production through electrolytic processes. Also includes other non-ferrous refining and smelting sources, such as those from magnesium and cobalt industry processes. |
| **OIL AND GAS INDUSTRY** | |
| **Disposal and Waste Treatment** | Treatment and disposal of any oilfield or processing waste fluids or produced water. Typically injected into a disposal well. |
| **Flaring and Incineration** | Routine or emergency disposal of waste gas by combustion using a flare stack or enclosed chamber. |
| **Heavy Crude Oil Cold Production** | Production of heavy crude oil which does not involve the use of any thermal techniques. Heavy crude oil is a category of crude oil characterized by relatively high viscosity, a higher carbon-to-hydrogen ratio, and a density greater than 900 kg/m$^3$ or more (25º or less American Petroleum Institute [API]). Heavy crude oil typically is more difficult to extract with conventional recovery techniques and is more costly to refine. |
| **Light/Medium Crude Oil Production** | Production of light- and medium-density crude oils characterized by relatively low viscosity, a lower carbon-to-hydrogen ratio and a density less than 900 kg/m$^3$ (greater than 25º API). |
| **Natural Gas Production and Processing** | Production of natural gas from natural gas wells, as well as associated gas production from oil wells. Processing of the raw natural gas to remove undesired constituents such as helium, ethane, natural gas liquids (NGLs), water, $H_2S$ and $CO_2$ to upgrade the quality of the natural gas to meet contract specifications. May also include the fractionation of mixed NGLs to natural gas products and possibly adjusting the heating value by the addition or removal of nitrogen. |
| **Natural Gas Transmission and Storage** | Transportation of sales-quality natural gas from the producers to market and storage of natural gas (typically in underground caverns) to accommodate the fluctuating differences between gas supply and demand rates. |
| **Natural Gas Distribution** | Local distribution of natural gas from the transmission system to the final end-users. |
| **In Situ Thermal Extraction** | Recovery of bitumen or heavy oil from a reservoir using a series of wells and thermal techniques. |
| **Oil Sands Mining, Extraction and Upgrading** | Recovery of bituminous sands using open-pit mining techniques, the extraction of bitumen from the mined ore through hot water and hydrocarbon solvent extraction, and the upgrading of bitumen into synthetic crude oil. |

| | |
|---|---|
| **Petroleum Liquids Storage** | Storage of liquid hydrocarbons (i.e., crude oil, diluted bitumen, natural gas liquids, condensate, etc.), including storage tank losses, loading/unloading and handling losses. |
| **Petroleum Liquids Transportation** | Transportation by pipeline, truck, rail and ship of liquid hydrocarbons, but does not include emissions from the vehicles themselves. |
| **Well Drilling/Servicing/Testing** | The drilling of wells to produce crude oil and natural gas. Well-related activities performed after drilling consisting of well completions, testing, workovers and abandonments. Sometimes the test may be conducted into a flow or gathering line; however, more often the liquids are produced into temporary tankage brought on site for the test, and the gas phase is either vented or flared. Emissions from diesel engines used to power the rigs are included in the off-road use of diesel. |
| **ELECTRIC POWER GENERATION (UTILITIES)** | |
| **Coal** | Electric power generation from combustion of coal by utilities (both publicly and privately owned) for commercial sales and/or private use. |
| **Diesel** | Electric power generation from combustion of diesel by utilities (both publicly and privately owned) for commercial sales and/or private use. |
| **Landfill Gas** | Electric power generation from combustion of landfill gas by utilities (both publicly and privately) for commercial sales and/or private use. |
| **Natural Gas** | Electric power generation from combustion of natural gas by utilities (both publicly and privately owned) for commercial sales and/or private use. |
| **Other (Electric Power Generation)** | Electric power generation from other energy sources by utilities (both publicly and privately owned) for commercial sales and/or private use. |
| **MANUFACTURING** | |
| **Construction Fuel Combustion** | Combustion of fossil fuels used for space heating and the heating of construction materials, such as concrete. |
| **Pulp and Paper Industry** | Chemical, mechanical, recycling and semi-chemical pulp mills, including the production of energy through the combustion of spent pulping liquor, biomass and fossil-fuel combustion. Also includes fugitive emissions from wood refining, screening and drying, and various steps in chemical recovery systems. |
| **Wood Products** | Sawmills, panelboard mills (including veneer, plywood, waferboard, particle board and medium-density fiberboard mills), and other wood products manufacturing establishments (including furniture and cabinet makers, wood treating plants, wood pellet mills and Masonite manufacturers). |
| **TRANSPORTATION AND MOBILE EQUIPMENT** | |
| **Air Transportation (LTO)** | Landing and takeoff (LTO) cycles from piston and turbine aircraft used for commercial and private operations. LTO cycles and cruise modes from piston and turbine aircraft used for military operations. |
| **Domestic Air Transportation (Cruise)** | Cruise modes from aircraft used for domestic commercial and private operations. |
| **Domestic Marine Navigation, Fishing and Military** | Marine vessels engaged in domestic navigation, fishing, or military operations within Canadian waters. |
| **International Air Transportation (Cruise)** | Cruise modes from aircraft used for international commercial and private operations. |
| **International Marine Navigation** | Marine vessels engaged in international navigation within Canadian waters. |
| **On-Road Transport – Diesel** | Diesel road vehicles, including light- and heavy-duty trucks, and automobiles. |
| **On-Road Transport – Gasoline** | Gasoline road vehicles, including light- and heavy-duty trucks, automobiles and motorcycles. |
| **On-Road Transport – Liquid Petroleum Gas** | Propane road vehicles, including light- and heavy-duty trucks, automobiles. |
| **On-Road Transport – Natural Gas** | Natural gas road vehicles, including light- and heavy-duty trucks, automobiles. |
| **Off-Road Transport – Diesel** | Off-road vehicles and mobile equipment using diesel fuel in mining, construction, agriculture, logging, railway maintenance and airport ground support; lawn and garden equipment, such as vehicles and equipment used for commercial purposes; and recreational vehicles. |

| | |
|---|---|
| **Off-Road Transport – Gasoline, Liquid Petroleum Gas and Natural Gas** | Off-road vehicles and mobile equipment using gasoline, liquid petroleum or compressed natural gas in mining, construction, agriculture, logging, railway maintenance, airport ground support, for commercial purposes, lawn and garden equipment or recreational vehicles. |
| **Rail Transportation** | Emissions from freight and passenger trains, including yard-switching activities. |
| **AGRICULTURE** | |
| **Agricultural Fuel Combustion** | Stationary combustion sources in agricultural facilities such as space and water heating and crop drying. |
| **COMMERCIAL/RESIDENTIAL/INSTITUTIONAL** | |
| **Commercial and Institutional Fuel Combustion** | Combustion of fossil and biogenic fuels used for space/water heating in commercial establishments, health and educational institutions and government/public administration facilities. |
| **Home Firewood Burning** | Burning of wood, pellets and manufactured logs as fuel for space heating and hot water. Includes emissions from fireplaces, wood stoves and wood-fired boilers. |
| **Residential Fuel Combustion** | Combustion of fossil fuels used for space/water heating in residences. |
| **Waste Incineration** | Incineration of municipal waste, sewage sludge, wastewater treatment residuals, hazardous waste, medical waste, and other waste types. Emissions from residential waste burning, flaring and utilization of landfill gas, and combustion emissions from crematoria (caskets and human bodies, as well as companion animals) are also included. |

# SUBMISSION TO THE UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE

Canada reports on black carbon emissions to the United Nations Economic Commission for Europe (UNECE) through the European Monitoring and Evaluation Programme (EMEP) Centre on Emission Inventories and Projections (CEIP) in conjunction with the 1979 Convention on Long-range Transboundary Air Pollution (CLRTAP) and its associated protocols. Black carbon was added as a component of fine particulate matter to the amended (2012) Gothenburg Protocol 1999, which calls for $PM_{2.5}$ reductions to focus on sources that have significant black carbon content, and for Parties to voluntarily report emissions and projections of black carbon. The black carbon emissions are reported for all years from 2013 and are submitted to UNECE at the same time as Canada's Air Pollutant Emissions Inventory.[1]

## A2.1 Overview of the United Nations Economic Commission for Europe Reporting Template

Canada is using the United Nations Economic Commission for Europe's (UNECE) Annex I emissions reporting template and the associated Nomenclature for Reporting (NFR) codes for reporting its black carbon emissions internationally. The UNECE NFR categories align with the sectors described in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2023 (EEA, 2023). In addition to providing technical guidance for developing inventory methodologies, the 2023 EMEP/EEA guidebook includes instructions for attributing sectoral emissions to NFR codes. Whereas the Black Carbon Inventory Report groups emissions by sectors (e.g., pulp and paper industry), the emissions in the UNECE are grouped by process and combustion sources. For example, the pulp and paper industry within the Black Carbon Inventory Report includes both combustion and process emissions. The black carbon emissions are associated with the combustion component which is mapped to NFR sector 1A2d (Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print). The process component is mapped to NFR sector 2H1 (Pulp and paper industry) which does not produce any black carbon emissions. Table **A2-1** illustrates the structure of the UNECE reporting template. The template, last revised November 18, 2019, can be found in its entirety on the CEIP website.[2]

## A2.2 Mapping of Black Carbon Inventory Emissions to the United Nations Economic Commission for Europe's Nomenclature for Reporting Categories

The mapping of black carbon inventory emissions to UNECE NFR categories is based on the mapping of the $PM_{2.5}$ emissions from the Air Pollutant Emissions Inventory (ECCC, 2026). As specified in section 3.1 of the present report, $PM_{2.5}$ emissions from combustion activities are used to estimate the black carbon emissions. In adherence to the UNECE NFR structure, most sectoral emissions from this inventory are redistributed into their combustion and process components following the 2023 EMEP/EEA guidebook.

Despite black carbon emissions stemming from combustion activities, not all black carbon emissions are necessarily mapped to combustion NFR codes under the UNECE structure. As an example, flaring emissions from the oil and gas industry are categorized under process, since they are considered fugitive emissions within the NFR categories. This distinction arises from the fact that flaring is the routine or emergency disposal of waste gas by combustion without utilization of the energy released.

In most cases, to redistribute emissions from the Black Carbon Inventory sectors to the NFR categories, ratios based on sources and pollutants are used to allocate emissions to the appropriate combustion and process NFR codes. In some instances, in-house estimation methodologies are used to produce detailed emissions by source, and emissions are assigned directly to the appropriate NFR code. A summary of Canada's black carbon emissions allocated into the respective NFR code is available on the Government of Canada Open Data website.[3]

## A2.3 Reporting International Marine Navigation and Air Transportation Emissions

The black carbon inventory reports marine and aviation differently than NFR tables. While the overall total of emissions for these sectors is the same, the allocation into different categories is different.

[1] https://www.canada.ca/en/environment-climate-change/services/pollutants/air-emissions-inventory-overview.html
[2] https://www.ceip.at/reporting-instructions/annexes-to-the-2023-reporting-guidelines/
[3] https://data-donnees.az.ec.gc.ca/data/substances/monitor/canada-s-black-carbon-inventory/

Table A2–1 **Excerpt from United Nations Economic Commission for Europe Nomenclature for Reporting Template for 2026**

**Annex 1: National Sector Emissions: Main Pollutants, Particulate Matter, Heavy Metals and Persistent Organic Pollutants**

| NFR aggregation for gridding and LPS (GNFR) | NFR sectors to be reported | | | Main pollutants (from 1990) | | | | Particulate matter (from 2000) | | | | Other (from 1990) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $NO_x$ (as $NO_2$) | NMVOC | $SO_x$ (as $SO_2$) | $NH_3$ | $PM_{2.5}$ | $PM_{10}$ | TSP | BC | CO |
| | NFR code | Long name | Notes | kt | kt | kt | kt | kt | kt | kt | kt | kt |
| A_PublicPower | 1 A 1 a | Public electricity and heat production | | | | | | | | | | |
| B_Industry | 1 A 1 b | Petroleum refining | | | | | | | | | | |
| B_Industry | 1 A 1 c | Manufacture of solid fuels and other energy industries | | | | | | | | | | |
| B_Industry | 1 A 2 a | Stationary combustion in manufacturing industries and construction: Iron and steel | | | | | | | | | | |
| B_Industry | 1 A 2 b | Stationary combustion in manufacturing industries and construction: Non-ferrous metals | | | | | | | | | | |
| B_Industry | 1 A 2 c | Stationary combustion in manufacturing industries and construction: Chemicals | | | | | | | | | | |
| B_Industry | 1 A 2 d | Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print | | | | | | | | | | |
| B_Industry | 1 A 2 e | Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco | | | | | | | | | | |
| B_Industry | 1 A 2 f | Stationary combustion in manufacturing industries and construction: Non-metallic minerals | | | | | | | | | | |
| I_Offroad | 1 A 2 g vii | Mobile combustion in manufacturing industries and construction: (please specify in your IIR) | | | | | | | | | | |
| B_Industry | 1 A 2 g viii | Stationary combustion in manufacturing industries and construction: Other (please specify in your IIR) | | | | | | | | | | |

Notes:
BC = black carbon
GNFR = Gridded nomenclature for reporting
IIR = Informative Inventory Report, which is equivalent to Air Pollutant Emissions Inventory Report (APEI) and Black Carbon Report in Canada
LPS = Large point source
NMVOC = Non-methane volatile organic compounds (refer to Annex 1 of the APEI for more information [canada.ca/apei])
TSP = Total suspended particles (equivalent to total particulate matter in the APEI)

The NFR table has five categories for marine: 1A3dii – National navigation (shipping), 1A4ciii – Agriculture/Forestry/Fishing: National fishing, 1A3di(i) – International maritime navigation, 1A3di(ii) – International inland waterways, and 1A5b – Other, Mobile (including military, land based and recreational boats). The Black Carbon Inventory Report includes all emissions occurring from domestic marine navigation (1A3dii), fishing vessels (1A4ciii) and military vessels (1A5b) in one category as those emissions contribute to Canada's national total. International marine navigation (excluding fishing and military operations) is reported in a separate table in the Black Carbon Inventory Report, the Air Pollutant Emissions Inventory (ECCC, 2026) and the NFR table, as those emissions do not contribute to Canada's national total. This is consistent with international reporting requirements. No values are reported under 1A3di(ii) – International inland waterways.

Similarly, the NFR table has five categories for aviation: 1A3ai(i) – International aviation landing/takeoffs (LTO) (civil), 1A3ai(ii) – International aviation cruise (civil), 1A3aii(i) – Domestic aviation LTO (civil), 1A3aii(ii) – Domestic aviation cruise (civil), and 1A5b – Other, Mobile (including military, land based and recreational boats). The Black Carbon Inventory Report includes all emissions occurring from civil LTO cycles—1A3ai(i) and 1A3aii(i)—and military flights (1A5b) in one category as those emissions contribute to Canada's national total. The emissions attributed to the cruise phase for civil flights are reported separately in the black carbon inventory report and the NFR table, as those emissions do not contribute to Canada's national total. This is consistent with international reporting requirements.

## References

[ECCC] Environment and Climate Change Canada. (2026). *Canada's Air Pollutant Emissions Inventory Report 1990–2024.* https://www.canada.ca/en/environment-climate-change/services/pollutants/air-emissions-inventory-overview.html

[EEA] European Environment Agency. (2023). *EMEP/EEA air pollutant emission inventory guidebook 2023.* https://www.eea.europa.eu/en/analysis/publications/emep-eea-guidebook-2023