

CANADA'S BLACK CARBON INVENTORY REPORT

2013–2020



2022



Environment and
Climate Change Canada

Environnement et
Changement climatique Canada

Canada 

Cat. No.: En81-25E-PDF
ISSN: 2369-9353
EC21273

This report is available in HTML at: canada.ca/black-carbon

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Telephone: 819-938-3860
Toll Free: 1-800-668-6767 (in Canada only)
Email: enviroinfo@ec.gc.ca

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Rapport d'inventaire des émissions de carbone noir du Canada 1990–2020

ACKNOWLEDGEMENTS

The Pollutant Inventories and Reporting Division (PIRD) of Environment and Climate Change Canada (ECCC) wishes to acknowledge the individuals and organizations that contributed to Canada's black carbon inventory and its report. PIRD would like to highlight the contributions of the following inventory developers, authors and/or reviewers, whose work helped to develop *Canada's Black Carbon Inventory Report 2013–2020* and estimates:

Michael Aide-Akhibi, Sean Angel, Alice Au, Pegah Baratzadeh, Owen Barrigar, Dominique Blain, Ashton Cunje, Vanessa Gagnon-Chantereau, Brandon Greenlaw, Valentina Idrissova, Jordon Kay, Geneviève LeBlanc-Power, Catherine Lee, Jonathan Lee, Monique Murphy, Raphaëlle Pelland St-Pierre, Lindsay Pratt, Catherine Robert, Duane Smith, Steve Smyth, Anne-Marie St-Laurent Thibault, Brittany Sullivan, Brett Taylor, Shawn Tobin, Kristine Tracey and Nick Zhao.

Operation and maintenance of a central compilation and reporting database was done by Pegah Baratzadeh. Coordination of the black carbon inventory report was led by Raphaëlle Pelland St-Pierre and Anne-Marie St-Laurent Thibault. Compilation and layout of the report for publication was carried out by Marida Waters with the support of Bruna Sunye. Web page development was carried out by David Maher. Editing and translation services were provided by Public Services and Procurement Canada.

Of the numerous people and organizations that provided support and information, we are especially indebted to the many individuals from the federal and provincial governments, industry and industry associations, consulting firms and universities who provided technical and scientific support.

Readers' Comments

Comments regarding the content of this report should be addressed to:

Lindsay Pratt, Acting Director
Pollutant Inventories and Reporting Division
Science and Risk Assessment Directorate
Science and Technology Branch
Environment and Climate Change Canada
Place Vincent Massey
351 Saint-Joseph Blvd.
Gatineau, QC Canada K1A 0H3
Email: apei-iepa@ec.gc.ca
Telephone: 1-877-877-8375

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LIST OF 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	European Monitoring and Evaluation Programme
EPG	electrical power generation
IE	included elsewhere
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
QA	quality assurance
QC	quality control
UNECE	United Nations Economic Commission for Europe
U.S. EPA	United States Environmental Protection Agency
VKT	Vehicle kilometres traveled

Units

kg/m ³	kilograms per cubic metre
kt	kilotonne
t	tonne
w/w	weight by weight (mass fraction)

EXECUTIVE SUMMARY

Black carbon is a component of particulate matter (PM) and a short-lived small aerosol (or airborne particle) linked to both climate warming and adverse health effects. Black carbon emissions are a focus of attention due to their effects on near-term warming of the atmosphere, human health and the environment. 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.

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. It includes a commitment from all Arctic states to develop and improve emission inventories for black carbon using, where possible, relevant guidelines from the Convention on Long-range Transboundary Air Pollution (CLRTAP). In 2017, the eight 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 November 2017, Canada ratified the Gothenburg Protocol and its 2012 amendments, which include black carbon as a component of fine particulate matter. The amended Gothenburg Protocol under CLRTAP is the first legally binding instrument to include a focus on black carbon. Canada's black carbon emissions 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.

This report presents the results of the 2022 edition of Canada's annual inventory of black carbon emissions. Emissions in this inventory are grouped according to the following source categories:¹

- 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.

In 2020, approximately 29 kilotonnes (kt) of black carbon were emitted in Canada (Table ES-1).² All emissions reported in this inventory are from anthropogenic (human) sources. Natural sources of black carbon, such as wildfires, are not included.

The most recent year for which data are available for this report, the year 2020, was marked by the COVID-19 pandemic, coinciding with an observed overall decrease in emissions of 2.6 kt or 8.2% between the years 2019 and 2020. This decrease is most notable in Transportation and Mobile Equipment where emissions decreased 1.7 kt or 9.0% mostly from off-road diesel equipment. There were less off-road diesel engines in use in 2020 relative to 2019, and they consumed less diesel fuel.

Transportation and Mobile Equipment is by far the largest source of black carbon in Canada, accounting for 17 kt (60%) of total emissions in 2020. Of the various sources in this category, off-road diesel engines account for 8.2 kt (28%) of total emissions in 2020. The other large source in this category is diesel engines used for on-road transport, which account for 5.5 kt (19%) of total emissions.

¹ Descriptions of sectors within the source categories can be found in Table A1-1.

² Throughout this report, data are presented as rounded figures. However, all calculations (including the ones to obtain percentages) have been performed using unrounded data.

Table ES-1 Canadian Black Carbon Emissions by Source Category and Sector (2013 to 2020)

Source Category and Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
ORE AND MINERAL INDUSTRIES	650	620	570	540	670	580	620	540
Aluminium Industry	51	45	36	35	34	30	30	32
Cement and Concrete Industry	14	15	19	15	16	20	17	13
Foundries ^a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron and Steel Industry	120	120	120	120	120	140	130	110
Iron Ore Pelletizing	6.3	6.6	7.1	7.3	6.3	5.7	6.5	5.5
Mining and Rock Quarrying	460	430	380	360	490	390	430	380
OIL AND GAS INDUSTRY	2 700	3 100	2 900	2 500	2 600	2 700	2 600	2 500
Disposal and Waste Treatment	0.12	0.13	0.13	0.12	0.12	0.10	0.10	0.10
Flaring	1 500	1 800	1 600	1 200	1 300	1 300	1 200	1 200
Heavy Crude Oil Cold Production	94	96	99	96	97	100	100	89
Light/Medium Crude Oil Production	160	160	160	150	150	160	160	150
Natural Gas Production and Processing	530	540	540	530	530	530	530	480
Natural Gas Transmission and Storage	34	32	32	35	36	36	37	37
Natural Gas Distribution	0.82	0.74	0.71	0.73	0.75	0.72	0.71	0.47
Oil Sands In-Situ Extraction	180	200	210	210	230	250	260	220
Oil Sands Mining, Extraction and Upgrading	200	310	250	250	290	280	270	280
Petroleum Liquids Storage	3.4	3.1	3.0	2.7	2.4	4.8	7.7	3.4
Petroleum Liquids Transportation	3.9	3.9	3.9	4.1	3.6	3.8	4.2	3.7
Well Drilling/Service/Testing	3.0	2.9	1.3	0.89	1.4	1.4	1.1	0.62
ELECTRIC POWER GENERATION (UTILITIES)	210	230	240	240	210	220	210	190
Coal	37	42	39	37	37	36	30	26
Diesel	130	150	160	160	130	140	140	120
Natural Gas	12	11	11	9.7	8.5	8.7	7.1	7.4
Other (Electric Power Generation)	29	34	34	36	31	32	31	30
MANUFACTURING	500	390	410	330	290	280	310	310
Pulp and Paper Industry	270	220	200	180	170	160	170	160
Wood Products	230	170	210	140	130	120	140	140
TRANSPORTATION AND MOBILE EQUIPMENT	24 000	22 000	20 000	17 000	18 000	19 000	19 000	17 000
Air Transportation (LTO)	230	220	210	210	210	230	230	140
Domestic Marine Navigation, Fishing and Military	1 600	1 700	800	820	850	900	1 000	980
On-Road Transport	7 700	7 000	6 300	6 200	6 500	6 700	6 700	6 200
Diesel	6 800	6 200	5 500	5 300	5 600	5 900	5 900	5 500
Gasoline	860	790	780	810	810	820	830	730
Liquid Petroleum Gas	0.49	0.20	0.15	0.18	0.21	0.21	0.21	0.14
Natural Gas	0.21	0.20	0.20	0.30	0.62	0.62	0.57	0.68
Off-Road Transport	13 000	11 000	11 000	8 400	9 100	9 700	9 600	8 600
Diesel	12 000	11 000	10 000	7 900	8 700	9 300	9 100	8 200
Gasoline and Natural Gas	500	510	510	450	460	470	470	440
Rail Transportation	1 900	1 800	1 500	1 400	1 400	1 600	1 600	1 500
AGRICULTURE	46	46	42	42	40	34	33	25
Agricultural Fuel Combustion	46	46	42	42	40	34	33	25
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	9 000	9 100	8 700	8 300	8 300	8 800	8 700	8 000
Commercial and Institutional Fuel Combustion	830	880	840	900	970	1 000	1 100	1 000
Construction Fuel Combustion	42	41	41	43	44	47	48	47
Home Firewood Burning	8 000	8 000	7 700	7 200	7 200	7 600	7 400	6 800
Fireplaces	900	870	800	730	700	830	910	850
Furnaces	5 100	5 100	4 900	4 700	4 800	4 800	4 400	4 000
Wood Stoves	2 000	2 000	1 900	1 700	1 600	2 000	2 200	2 000
Residential Fuel Combustion	160	160	150	140	150	160	150	140
TOTAL	37 000	36 000	33 000	29 000	30 000	32 000	32 000	29 000

Notes:

Totals may not add up due to rounding.

Values in this report have been rounded to two significant digits.

a. The Foundries sector is being considered for omission from future inventories. If you have any questions, please contact us at apei-iepa@ec.gc.ca or 1-877-877-8375.

0.00 Indicates emissions were truncated due to rounding.

Other emissions estimated in the black carbon inventory

Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
Domestic Air Transportation (Cruise)	230	220	210	210	230	250	250	140
International Air Transportation (Cruise)	370	360	370	380	420	480	490	230
International Marine Navigation	3 200	3 700	1 600	1 600	1 500	1 500	1 600	1 400

Note: Refer to Chapter 2.5 for more information on Transportation and Mobile Equipment emissions reporting.

Commercial/Residential/Institutional fuel combustion is the second-largest contributor to black carbon emissions in Canada, accounting for 8.0 kt of black carbon, or 28% of total emissions in 2020. Home Firewood Burning is the largest source in this category, making up 6.8 kt of black carbon, or 23% of total 2020 emissions. Wood is an abundant fuel source in Canada, and it is estimated that 6.6 million tonnes of firewood were burned in Canadian homes in 2020, a decrease of 24% since 2015 (ECCC, 2020).

Since 2013, black carbon emissions in Canada have decreased overall by 8.1 kt (22%). 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). More information on black carbon emissions and trends in Canada can be found in Chapter 2 and on estimation methods in Chapter 3.

Irrespective of the downward trend observed in Canadian emissions, 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 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.

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 days to 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 warming, regional cloud formation, and precipitation patterns. When black carbon particles settle on snow and ice, they darken the surface, reducing its 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 new commitments to reduce emissions of PM_{2.5} by 25% from 2005 levels by 2020 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 2022 edition of Canada's annual inventory of anthropogenic black carbon emissions, covering the years from 2013 to 2020. 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 34 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 2022 APEI. Please refer to Chapter 3 and Annex 2 of the APEI report (Environment and Climate Change Canada [ECCC], 2022) 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.

BLACK CARBON EMISSIONS AND TRENDS IN CANADA

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This chapter describes the main sources and sectors contributing to black carbon (BC) emissions and their trends since 2013. Emissions have been grouped according to the following source 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 source categories, emissions are further split into sectors.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 sources of emissions in this report and are excluded from Canada's national total emissions.

In 2020, approximately 29 kilotonnes (kt) of black carbon were emitted in Canada (Table 2–1). The most recent year for which data are available for this report, the year 2020, was marked by the COVID-19 pandemic, coinciding with an observed overall decrease in emissions of 2.6 kt or 8.2% between the years 2019 and 2020.

Transportation and Mobile Equipment category is by far the largest source of black carbon in Canada, accounting for 17 kt (60%) of total emissions in 2020. Mobile diesel engines alone, which include both on-road and off-road diesel vehicles, accounted for 14 kt (47%) of total emissions.

Commercial/Residential/Institutional sources are the second-largest contributor to black carbon emissions in Canada, making up 8.0 kt or 28% of total emissions in 2020. Home Firewood Burning is the largest source in this category, accounting for 6.8 kt or 23% of total emissions. Wood is an abundant fuel source in Canada, and it is estimated that approximately 6.6 million tonnes of firewood were burned in Canadian homes in 2020, a decrease of about 24% since 2015 (ECCC, 2020).

Since 2013, black carbon emissions in Canada have decreased overall by 8.1 kt (22%) in 2020. (Figure 2–1). This decrease is attributed to declining emissions from the Transportation and Mobile Equipment category (6.6 kt or 27%). Emissions from Commercial/Residential/Institutional fuel combustion have decreased from 9.0 kt in 2013 to 8.0 kt in 2020 (1.0 kt or 11%). The Oil and Gas Industry sources have shown an overall decrease in emissions from 2.7 kt in 2013 to 2.5 kt in 2020 (0.20 kt or 7.3%).

Details on each of the source categories and their associated sectors can be found in sections 2.1 to 2.7. An overview of the methods used to develop the black carbon inventory, improvements applied to this edition of the inventory, sources of uncertainty and future refinements are described in Chapter 3. Provincial and territorial estimates of black carbon emissions are provided in Section 2.8 and Annex 4.

¹ See Annex 1 for descriptions of sectors.

Table 2-1 **Black Carbon Emissions in Canada (2020)**

Source Category and Sector	Black Carbon (tonnes)	Percentage of total
ORE AND MINERAL INDUSTRIES	540	1.9%
Aluminium Industry	32	0.1%
Cement and Concrete Industry	13	0.0%
Foundries ^a	0.00	0.0%
Iron and Steel Industry	110	0.4%
Iron Ore Pelletizing	5.5	0.0%
Mining and Rock Quarrying	380	1.3%
OIL AND GAS INDUSTRY	2 500	8.6%
Disposal and Waste Treatment	0.10	0.0%
Flaring	1 200	4.1%
Heavy Crude Oil Cold Production	89	0.3%
Light/Medium Crude Oil Production	150	0.5%
Natural Gas Production and Processing	480	1.7%
Natural Gas Transmission and Storage	37	0.1%
Natural Gas Distribution	0.47	0.0%
Oil Sands In-Situ Extraction	220	0.8%
Oil Sands Mining, Extraction and Upgrading	280	1.0%
Petroleum Liquids Storage	3.4	0.0%
Petroleum Liquids Transportation	3.7	0.0%
Well Drilling/Service/Testing	0.62	0.0%
ELECTRIC POWER GENERATION (UTILITIES)	190	0.7%
Coal	26	0.1%
Diesel	120	0.4%
Natural Gas	7.4	0.0%
Other (Electric Power Generation)	30	0.1%
MANUFACTURING	310	1.1%
Pulp and Paper Industry	160	0.6%
Wood Products	140	0.5%
TRANSPORTATION AND MOBILE EQUIPMENT	17 000	59%
Air Transportation (LTO)	140	0.5%
Domestic Marine Navigation, Fishing and Military	980	3.4%
On-Road Transport	6 200	21%
Diesel	5 500	19%
Gasoline	730	2.5%
Liquid Petroleum Gas	0.14	0.0%
Natural Gas	0.68	0.0%
Off-Road Transport	8 600	30%
Diesel	8 200	28%
Gasoline and Natural Gas	440	1.5%
Rail Transportation	1 500	5.2%
AGRICULTURE	-	-
Agricultural Fuel Combustion	25	0.1%
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	8 000	28%
Commercial and Institutional Fuel Combustion	1 000	3.4%
Construction Fuel Combustion	47	0.2%
Home Firewood Burning	6 800	23%
Fireplaces	850	2.9%
Furnaces	4 000	14%
Wood Stoves	2 000	6.9%
Residential Fuel Combustion	140	0.5%
TOTAL	29 000	100%

Notes:

Totals may not add up due to rounding.

Values in this report have been rounded to two significant digits.

a. The Foundries sector is being considered for omission from future inventories. If you have any questions, please contact us at apei-iepa@ec.gc.ca or 1-877-877-8375.

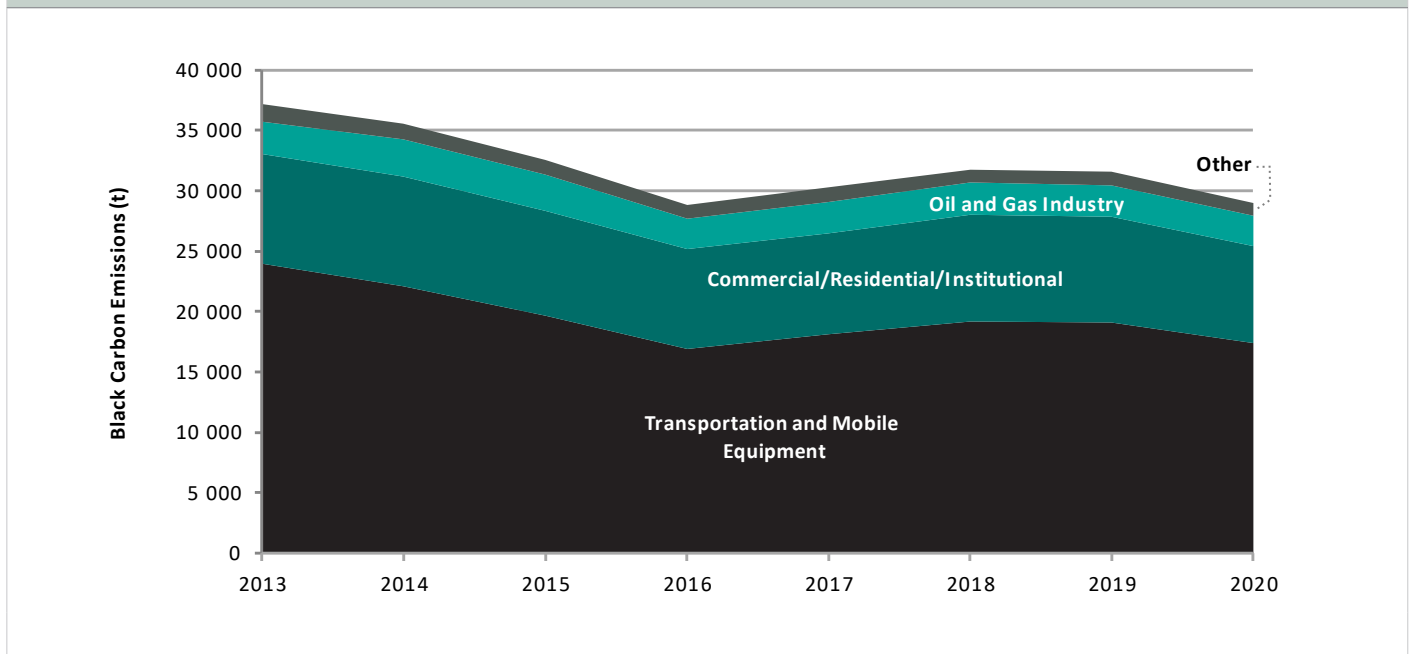
0.00 Indicates emissions were truncated due to rounding.

Other emissions estimated in the black carbon inventory

Sector	Black Carbon (tonnes)	Percentage of total
Domestic Air Transportation (Cruise)	140	8%
International Air Transportation (Cruise)	230	13%
International Marine Navigation	1 400	79%

Note: Refer to Chapter 2.5 for more information on Transportation and Mobile Equipment emissions reporting.

Figure 2–1 Trends in Canadian Black Carbon Emissions (2013 to 2020)



2.1. Ore and Mineral Industries

Sources in the Ore and Mineral Industries category include primary resource extraction and processing (Table 2–2 and Figure 2–2). For the purpose of this inventory, black carbon emissions were considered for the following industries:

- Aluminium
- Cement and Concrete
- Foundries
- Iron and Steel
- Iron Ore Pelletizing
- Mining and Rock Quarrying

Greater sectoral coverage and further refinement of emissions from Ore and Mineral Industries are expected in future editions of the inventory.

Of all sources in the Ore and Mineral Industries category included in this inventory, the Mining and Rock Quarrying sector accounted for the largest proportion (1.3% or 0.38 kt) of total black carbon emissions in 2020 (Figure 2–2). Black carbon emissions from Mining and Rock Quarrying remained relatively stable since 2013, ranging between 0.36 and 0.49 kt. The use of diesel to generate electricity at remote mines in northern areas, combined with the relatively high BC/PM_{2.5} fraction for diesel relative to other fuels, is a significant contributor to this sector.

The second-largest source of black carbon emissions in the Ore and Mineral Industries category is the Iron and Steel Industry, which accounted for 0.11 kt or 0.4% of total black carbon emissions in 2020. Emissions from this sector have decreased by 9% since 2013. This is due to a 17% decrease in iron and steel production from 2019 to 2020 (ECCC, 2021).

The Aluminium Industry sector emitted 0.03 kt of black carbon, or 0.1% of the national total, a decrease of 0.02 kt or 36% since 2013. The decrease can be attributed to the closures of the last three Söderberg aluminium smelters between 2013 and 2015.²

² Banville J. 2020. Personal communication (email from Banville J to Au A, ECCC, dated June 15, 2020). Environmental Protection Branch, Environment and Climate Change Canada.

Table 2-2 Emissions of Combustion PM_{2.5} and Black Carbon from Ore and Mineral Industries (2013 to 2020)

Sector	PM _{2.5} from combustion (tonnes)								Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020	2013	2014	2015	2016	2017	2018	2019	2020
Aluminium Industry	2 300	2 100	1 700	1 600	1 600	1 400	1 400	1 500	51	45	36	35	34	30	30	32
Cement and Concrete Industry	740	800	950	800	790	940	850	660	14	15	19	15	16	20	17	13
Foundries ^a	3.4	3.0	2.9	2.6	1.8	0.10	0.80	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron and Steel Industry	1 700	2 100	1 900	1 800	2 200	2 300	2 300	2 000	120	120	120	120	120	140	130	110
Iron Ore Pelletizing	730	760	820	850	730	660	750	640	6.3	6.6	7.1	7.3	6.3	5.7	6.5	5.5
Mining and Rock Quarrying	2 800	2 300	1 700	1 700	2 200	2 000	2 400	2 600	460	430	380	360	490	390	430	380
TOTAL	8 300	8 100	7 000	6 800	7 500	7 400	7 700	7 300	650	620	570	540	670	580	620	540

Notes:

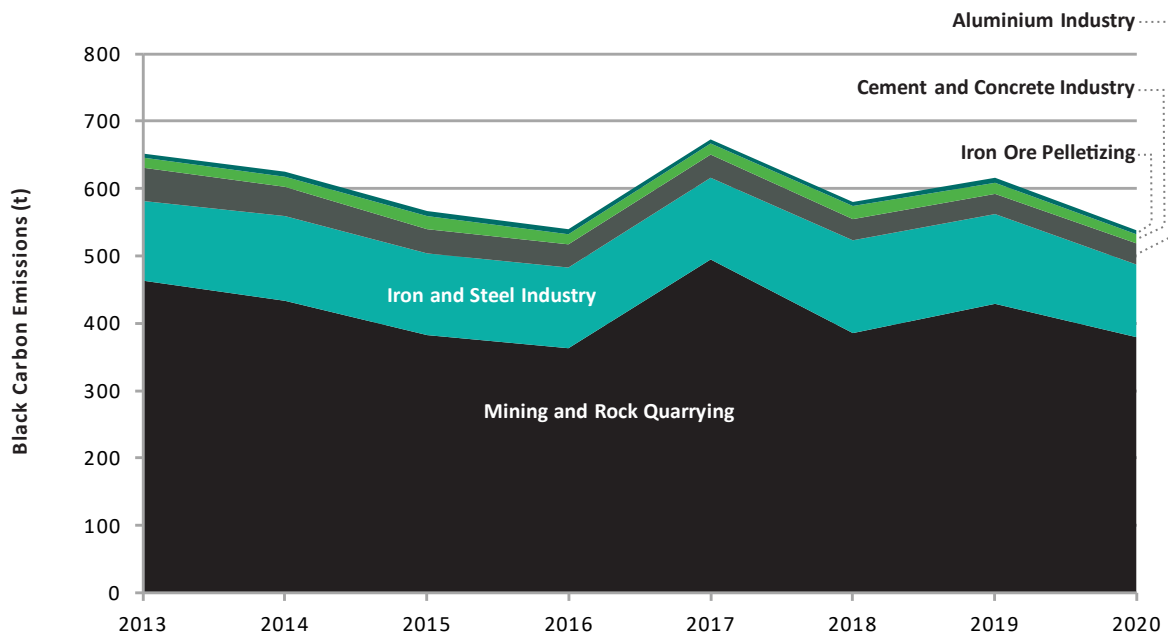
Totals may not add up due to rounding.

Values in this report have been rounded to two significant digits.

a. The Foundries sector is being considered for omission from future inventories. If you have any questions, please contact us at apei-iepa@ec.gc.ca or 1-877-877-8375.

0.00 Indicates emissions were truncated due to rounding.

Figure 2-2 Trends in Canadian Black Carbon Emissions from Ore and Mineral Industries (2013 to 2020)



2.2. Oil and Gas Industry

The Oil and Gas Industry accounted for 2.5 kt or 8.6% of all black carbon emitted in 2020. Oil and Gas Industry sources include combustion activities resulting in black carbon emissions, mostly within the upstream oil and gas industry (Table 2–3 and Figure 2–3). The sectors presented below are included in this year’s report. While flaring occurs in many of the upstream oil and gas sectors, it is presented separately since it is a significant source of black carbon emissions.

- Disposal and Waste Treatment
- Flaring
- Heavy Crude Oil Cold Production
- Light/Medium Crude Oil Production
- Natural Gas Production and Processing
- Natural Gas Transmission and Storage
- Natural Gas Distribution
- Oil Sands In-Situ Extraction
- Oil Sands Mining, Extraction and Upgrading
- Petroleum Liquids Storage
- Petroleum Liquids Transportation
- Well Drilling/Service/Testing

Since 2013, black carbon emissions from the Oil and Gas industry have decreased by 0.20 kt or 7.3%. Of all Oil and Gas sectors included in this inventory, Flaring accounted for the largest proportion (4.3% or 1.2 kt) of total black carbon emissions in 2020 (Figure 2–3). Emissions from this sector have decreased by 0.26 kt or 17% between 2013 and 2020. Emissions from flaring are directly related to volumes of gas flared in the industry. From 2016 to 2018, volumes of flared gas increased as operators reduced the volumes of vented gas. Flaring is preferred to venting as it reduces emissions of methane and non-methane volatile organic compounds. It does, however, increase emissions of carbon monoxide, particulate matter (PM) (and hence black carbon) and nitrogen oxides. From 2018 to 2020 the volume of gas flared was relatively consistent.

The next two largest sources of black carbon emissions in this category are Natural Gas Production and Processing, which accounted for 0.48 kt or 1.7% of total black carbon emissions, and Oil Sands Mining, Extraction and Upgrading, which accounted for 0.28 kt or 1.0% of total black carbon emissions. Since 2013, black carbon emissions have increased from Oil Sands Mining, Extraction and Upgrading and from Oil Sands In-Situ Extraction by a combined total of 0.12 kt (31%). This is consistent with a 52% increase in crude bitumen production from mining operations and a 61% increase in crude bitumen production from in-situ thermal extraction facilities, both of which contribute to increased fuel combustion and flaring activities.

Table 2–3 Emissions of Combustion PM_{2.5} and Black Carbon from Oil and Gas Industry (2013 to 2020)

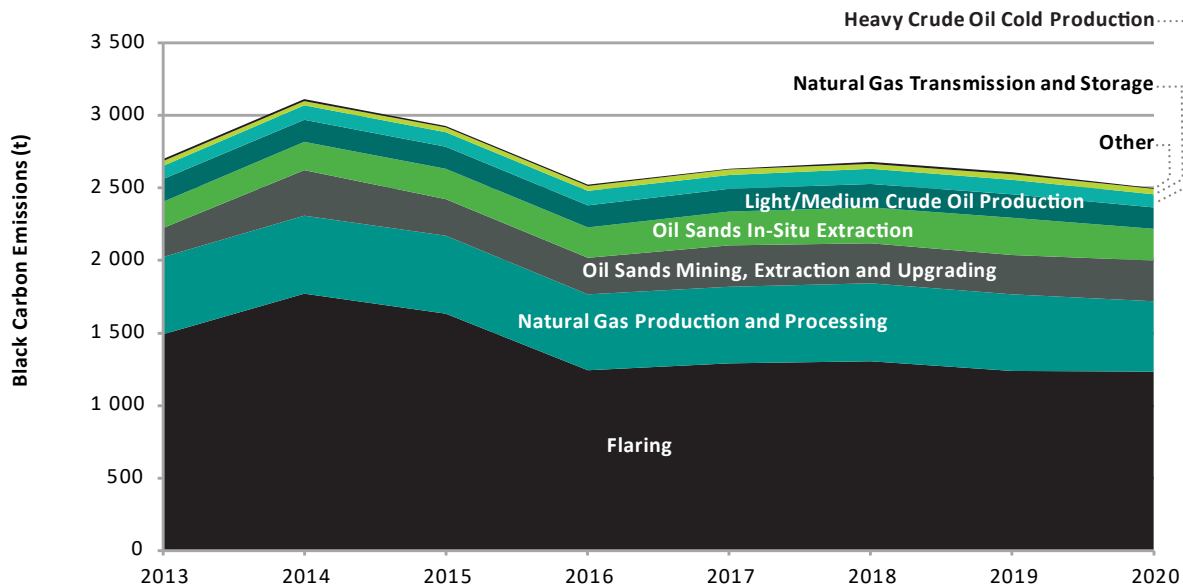
Sector	PM _{2.5} from combustion (tonnes)								Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020	2013	2014	2015	2016	2017	2018	2019	2020
Disposal and Waste Treatment	0.30	0.34	0.33	0.30	0.30	0.27	0.23	0.18	0.12	0.13	0.13	0.12	0.12	0.10	0.10	0.10
Flaring	5 200	6 100	5 900	5 000	5 600	5 200	5 100	5 500	1 500	1 800	1 600	1 200	1 300	1 300	1 200	1 200
Heavy Crude Oil Cold Production	160	170	170	160	170	170	170	150	94	96	99	96	97	100	100	89
Light/Medium Crude Oil Production	300	300	290	290	290	300	300	280	160	160	160	150	150	160	160	150
Natural Gas Production and Processing	1 400	1 400	1 400	1 300	1 300	1 400	1 300	1 200	530	540	540	530	530	530	530	480
Natural Gas Transmission and Storage	88	83	84	92	93	94	96	97	34	32	32	35	36	36	37	37
Natural Gas Distribution	2.1	1.9	1.9	1.9	2.0	1.9	1.8	1.2	0.82	0.74	0.71	0.73	0.75	0.72	0.71	0.47
Oil Sands In-Situ Extraction	460	500	530	540	600	640	660	560	180	200	210	210	230	250	260	220
Oil Sands Mining, Extraction and Upgrading	1 300	2 200	1 600	1 700	1 900	1 900	1 800	1 900	200	310	250	250	290	280	270	280
Petroleum Liquids Storage	9.0	8.1	7.9	6.9	6.1	13	20	8.8	3.4	3.1	3.0	2.7	2.4	4.8	7.7	3.4
Petroleum Liquids Transportation	10	10	10	11	9.3	9.8	11	9.6	3.9	3.9	3.9	4.1	3.6	3.8	4.2	3.7
Well Drilling/Service/Testing	3.9	3.8	1.7	1.2	1.9	1.9	1.4	0.81	3.0	2.9	1.3	0.89	1.4	1.4	1.1	0.62
TOTAL	8 900	11 000	9 900	9 100	10 000	9 700	9 600	9 700	2 700	3 100	2 900	2 500	2 600	2 700	2 600	2 500

Notes:

Totals may not add up due to rounding.

Values in this report have been rounded to two significant digits.

Figure 2-3 Trends in Canadian Black Carbon Emissions from Oil and Gas Industry (2013 to 2020)



Note: "Other" includes the Disposal and Waste Treatment, Natural Gas Distribution, Petroleum Liquids Storage, Petroleum Liquids Transportation and Well Drilling/Service/Testing sectors.

2.3. Electric Power Generation (Utilities)

Electric Power Generation (Utilities) sources include the combustion of coal, diesel, natural gas and other fuels for the purpose of generating electricity (Table 2-4).

Electric Power Generation (Utilities) accounted for 0.19 kt (0.7%) of all black carbon emissions in 2020 (Table 2-4 and Figure 2-4) with a 0.03 kt (12 %) reduction in emissions since 2013. Black carbon emissions from this source category are relatively low. Large facilities using solid fuels are equipped with particulate controls, while boilers and heaters using liquid and gaseous fuels emit relatively little particulate matter. There is relatively little diesel fuel used in large stationary electricity generation applications.

Coverage for this source category is nearly complete; the remaining small sources (smaller facilities including those in remote communities that do not report their emissions to the National Pollutant Release Inventory [NPRI]) will be addressed in future inventories. Emissions from these sources, though small nationally, can have important regional atmospheric and air quality impacts in such areas as Canada's North.

The largest emitter of black carbon in this category is Diesel electric power generation, which accounts for 0.12 kt (0.4 %) of total black carbon emissions in 2020, and over 60% of the black carbon in this category. The trend is largely influenced by fluctuations in diesel-fired electricity generation. In 2020, black carbon emissions from diesel-fired electric power generation decreased from their 2013 level; but the influence of diesel on the category increased so it represents 68% of emissions in 2020 (up from 62%). Black carbon emissions decreased between 2013 and 2020 for both Coal and Natural Gas electric power generation. The reduction in emissions from coal-fired electricity generation is due to the coal plant closures in Ontario and reduced coal consumption in Alberta; while reductions in emissions from natural gas-fired electricity generation is due to reduced generation from natural gas offset by increased generation from renewable sources.

Table 2-4 Emissions of Combustion PM_{2.5} and Black Carbon from Electric Power Generation (Utilities) (2013 to 2020)

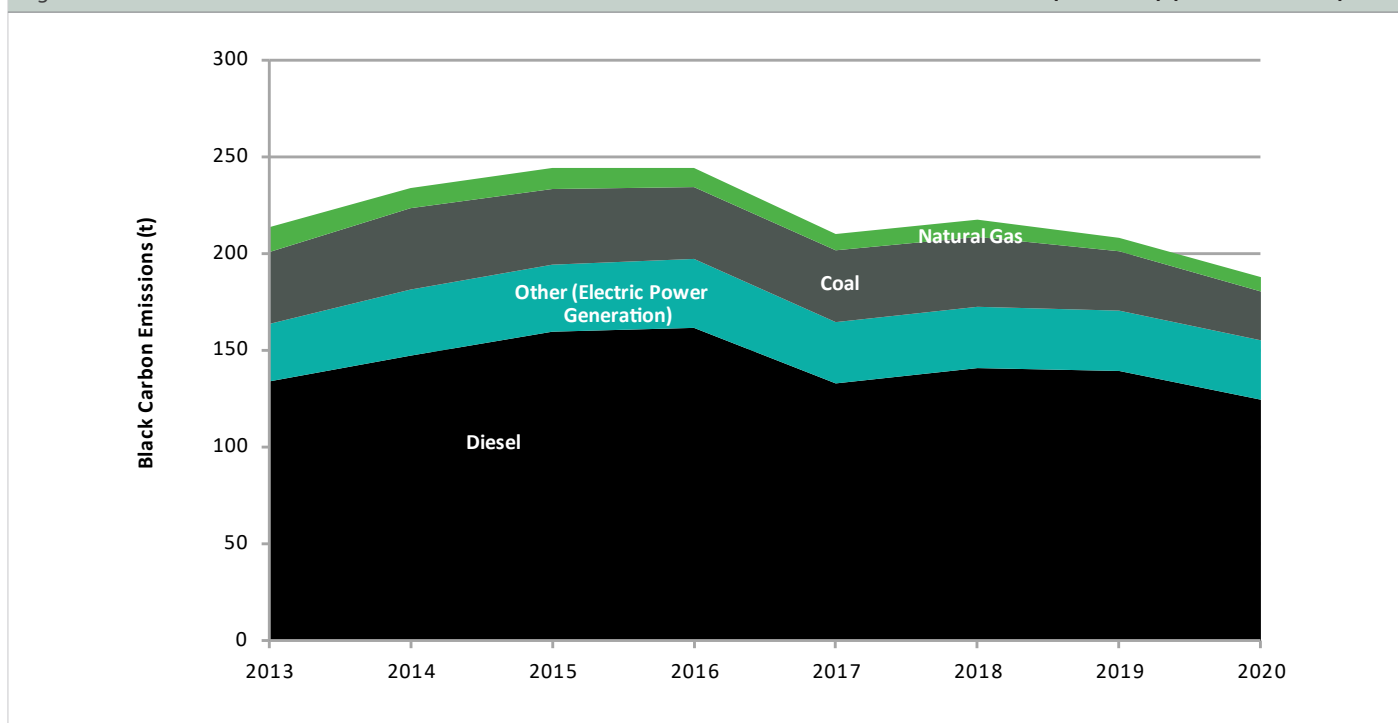
Sector	PM _{2.5} from combustion (tonnes)								Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020	2013	2014	2015	2016	2017	2018	2019	2020
Coal	2 200	2 500	2 300	2 200	2 200	2 100	1 800	1 500	37	42	39	37	37	36	30	26
Diesel	170	190	210	210	170	180	180	160	130	150	160	160	130	140	140	120
Natural Gas	500	420	420	390	340	350	290	300	12	11	11	9.7	8.5	8.7	7.1	7.4
Other (Electric Power Generation)	300	420	430	510	500	430	440	400	29	34	34	36	31	32	31	30
TOTAL	3 200	3 500	3 400	3 300	3 200	3 100	2 700	2 400	210	230	240	240	210	220	210	190

Notes:

Totals may not add up due to rounding.

Values in this report have been rounded to two significant digits.

Figure 2-4 Trends in Canadian Black Carbon Emissions from Electric Power Generation (Utilities) (2013 to 2020)



2.4. Manufacturing

Manufacturing sources include the Pulp and Paper Industry and Wood Products sectors (Table 2-5). They accounted for 0.31 kt or 1.1% of total black carbon emissions in 2020. While there are other manufacturing sectors, only those with significant PM_{2.5} emissions from combustion are included in this inventory.

The decreasing trend in this source category between 2013 and 2020 (0.19 kt or 38%) is largely consistent with reduced production in both the Pulp and Paper Industry sector and the Wood Products sector.

Table 2-5 Emissions of Combustion PM_{2.5} and Black Carbon from Manufacturing (2013 to 2020)

Sector	PM _{2.5} from combustion (tonnes)								Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020	2013	2014	2015	2016	2017	2018	2019	2020
Pulp and Paper Industry	8 200	7 600	6 900	6 300	5 800	5 400	5 000	5 100	270	220	200	180	170	160	170	160
Wood Products	3 200	2 500	2 800	2 100	1 900	1 900	2 200	2 200	230	170	210	140	130	120	140	140
TOTAL	11 000	10 000	9 700	8 500	7 800	7 300	7 300	7 400	500	390	410	330	290	280	310	310

Notes:

Totals may not add up due to rounding.

Values in this report have been rounded to two significant digits.

2.5. Transportation and Mobile Equipment

Transportation and Mobile Equipment includes black carbon emissions from Air Transportation (Landing and Takeoff [LTO]), Domestic Marine Navigation, Fishing and Military, On-Road and Off-Road Transport (diesel, gasoline, liquid petroleum gas and natural gas) and Rail Transportation sectors (Table 2–6 and Figure 2–5). Off-Road Transport is a highly diverse sector that includes lawn and garden equipment; recreational vehicles, such as pleasure craft and snowmobiles; farm equipment; construction and mining equipment; and portable generators and pumps. Both on-road and off-road diesel engines are subject to emission standards for particulate matter (PM) and are equipped with sophisticated emission controls to reduce PM emissions. As more new engines equipped with this technology replace older, more polluting engines, it is expected that PM and black carbon emissions will exhibit an overall decreasing trend.

The Transportation and Mobile Equipment category is by far the largest source of black carbon in Canada, accounting for 17 kt (60%) of total emissions in 2020 (Table 2–1). An important source in this category is mobile diesel engines, both on-road and off-road, which accounted for 47% (14 kt) of total emissions. Larger sources of black carbon are those that either emit large quantities of PM_{2.5}, or those for which the BC/PM_{2.5} fraction is high. Mobile diesel engines emit significant quantities of PM_{2.5} and have the highest BC/PM_{2.5} fractions of all black carbon sources (Table 2–6). As a result, mobile diesel engines account for nearly all emissions from this category, or almost half of total black carbon emissions. The implementation of effective fuel and engine regulations for on-road and off-road diesel resulted in decreasing emissions between 2013 and 2020 by 19% (1.3 kt) and 33% (4.0 kt) respectively, contributing to 65% of the overall decrease in the national total. 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 3.8 kt and 13% of the total black carbon emitted in 2020.

Compared to 2019, black carbon emissions from Transportation and Mobile Equipment overall decreased by 1.7 kt or 9.0% in 2020 mostly from off-road diesel equipment. There were less of these engines in use in 2020 relative to 2019, and consumed less diesel fuel. Emission reductions were also observed in all aviation categories (82 t or 36% for Air Transportation [LTO]) linked with a decrease in air traffic in 2020 relative to 2019.

Emissions from Domestic Air Transportation (Cruise), International Air Transportation (Cruise) and International Marine Navigation are reported as separate items because they do not contribute to Canada’s national total. This is based on the Nomenclature for Reporting (NFR) used in the submission to the UNECE. For more information on Canada’s submission to UNECE, refer to Annex 3.

Table 2–6 Emissions of Combustion PM_{2.5} and Black Carbon from Transportation and Mobile Equipment (2013 to 2020)

Sector	PM _{2.5} from combustion (tonnes)								Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020	2013	2014	2015	2016	2017	2018	2019	2020
Air Transportation (LTO)	300	280	280	270	280	300	290	190	230	220	210	210	210	230	230	140
Domestic Marine Navigation, Fishing and Military	3 300	3 100	1 400	1 400	1 500	1 500	1 600	1 400	1 600	1 700	800	820	850	900	1 000	980
On-Road Transport	14 000	13 000	12 000	12 000	12 000	13 000	13 000	12 000	7 700	7 000	6 300	6 200	6 500	6 700	6 700	6 200
Diesel	11 000	9 700	8 600	8 400	8 900	9 300	9 200	8 600	6 800	6 200	5 500	5 300	5 600	5 900	5 900	5 500
Gasoline	3 800	3 400	3 300	3 500	3 500	3 500	3 500	3 100	860	790	780	810	810	820	830	730
Liquid Petroleum Gas	2.3	0.83	0.64	0.74	0.88	0.89	0.87	0.60	0.49	0.20	0.15	0.18	0.21	0.21	0.21	0.14
Natural Gas	1.1	1.0	1.0	1.5	3.0	3.0	2.8	3.3	0.21	0.20	0.20	0.30	0.62	0.62	0.57	0.68
Off-Road Transport	20 000	18 000	18 000	14 000	15 000	16 000	16 000	14 000	13 000	11 000	11 000	8 400	9 100	9 700	9 600	8 600
Diesel	16 000	14 000	13 000	10 000	11 000	12 000	12 000	11 000	12 000	11 000	10 000	7 900	8 700	9 300	9 100	8 200
Gasoline and Natural Gas	4 100	4 200	4 100	3 600	3 700	3 800	3 800	3 500	500	510	510	450	460	470	470	440
Rail Transportation	2 500	2 300	2 000	1 800	1 900	2 000	2 000	1 900	1 900	1 800	1 500	1 400	1 400	1 600	1 600	1 500
TOTAL	40 000	37 000	33 000	29 000	31 000	33 000	32 000	29 000	24 000	22 000	20 000	17 000	18 000	19 000	19 000	17 000

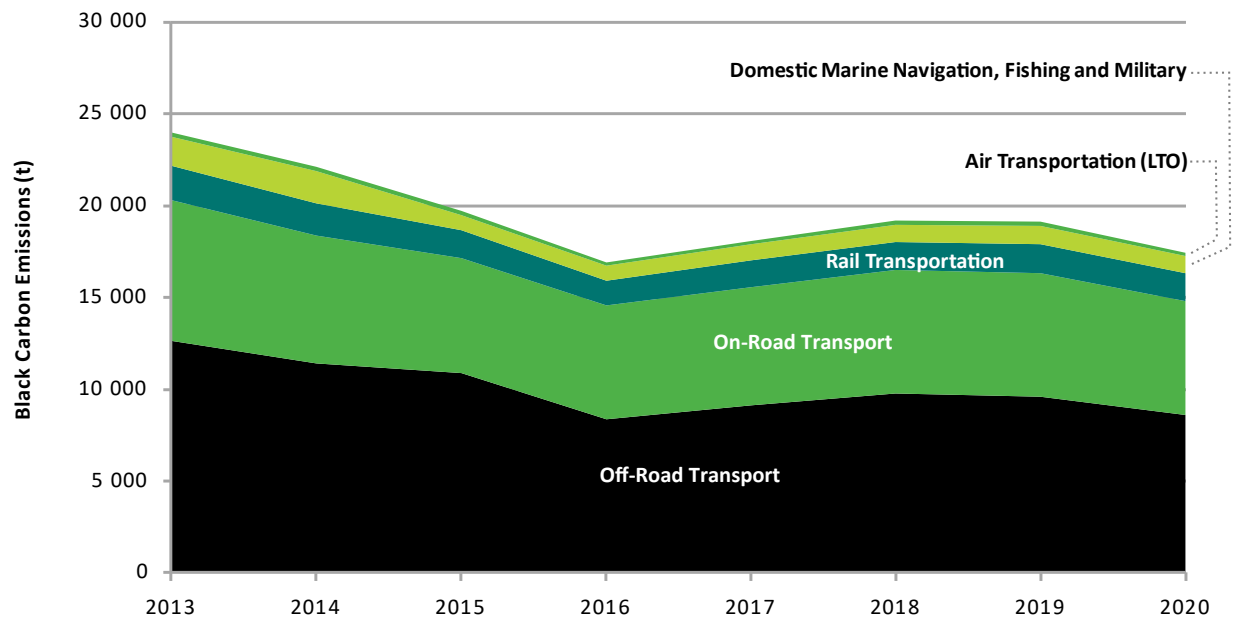
Notes:
Totals may not add up due to rounding.
Values in this report have been rounded to two significant digits.

Other emissions estimated in the black carbon inventory

Sector	PM _{2.5} from combustion (tonnes)								Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020	2013	2014	2015	2016	2017	2018	2019	2020
Domestic Air Transportation (Cruise)	290	280	280	280	300	320	330	180	230	220	210	210	230	250	250	140
International Air Transportation (Cruise)	480	470	480	500	540	620	640	290	370	360	370	380	420	480	490	230
International Marine Navigation	7 100	6 500	2 300	2 300	2 300	2 300	2 300	1 900	3 200	3 700	1 600	1 600	1 500	1 500	1 600	1 400

Note:
Refer to chapter 2.5 for more information.

Figure 2–5 Trends in Canadian Black Carbon Emissions from Transportation and Mobile Equipment (2013 to 2020)



2.6. Agriculture

Agriculture sources consist of Agricultural Fuel Combustion for non-mobile equipment (e.g., for drying grain, heating barns) and accounted for 0.03 kt (0.1%) of total black carbon emitted in 2020 (Table 2–7). Since 2013, emissions of black carbon from this source decreased by 21 t or 45% in 2020. In 2013 and 2020, Alberta contributed 60% and 73%, respectively of the total black carbon emissions from Agricultural Fuel Combustion. The decrease in black carbon emissions between 2013 and 2020 is a result of decreased coal consumed in non-mobile equipment in Alberta.

Table 2–7 Emissions of Combustion PM_{2.5} and Black Carbon from Agriculture (2013 to 2020)

Sector	PM _{2.5} from combustion (tonnes)								Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020	2013	2014	2015	2016	2017	2018	2019	2020
Agricultural Fuel Combustion	320	310	290	290	280	260	260	220	46	46	42	42	40	34	33	25
TOTAL	320	310	290	290	280	260	260	220	46	46	42	42	40	34	33	25

Notes:

Totals may not add up due to rounding.

Values in this report have been rounded to two significant digits.

2.7. Commercial/Residential/Institutional Sources

Commercial/Residential/Institutional sources include Home Firewood Burning, Commercial and Institutional Fuel Combustion Construction Fuel Combustion and Residential Fuel Combustion. The majority of emissions from these sources are due to combustion in large, relatively efficient commercial boilers, or in small, less-efficient residential fireplaces and woodstoves.

Of all Commercial/Residential/Institutional sources, Home Firewood Burning accounted for the largest proportion (6.8 kt or 23%) of total black carbon emissions in 2020 (Table 2–8). Emissions from Home Firewood Burning are split into the following subsectors:

- Fireplaces
- Furnaces
- Wood Stoves

A key determinant of total emissions from Home Firewood Burning is the quantity of wood burned in each type of wood-burning device (residential wood stoves, furnaces and fireplaces). The decreasing trend in this sector between 2013 and 2020 (1.2 kt or 15%) 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. Between 2019 and 2020, emissions from this source decreased by 0.63 kt or 8.4% due a warmer heating season in 2020, as indicated by an 8% decrease in heating degree-days.

The next largest source of black carbon emissions in this category is Commercial and Institutional Fuel Combustion, which accounted for 1.0 kt (3.6%) of total black carbon emissions.

Overall, the combustion of fuels, other than wood, accounted for 1.2 kt (4.3%) of total black carbon emissions from this category in 2020. Estimates for these sources are based on the fuel type and quantity consumed in Canada and the corresponding BC/PM_{2.5} fraction for each sector.

Table 2–8 Emissions of Combustion PM_{2.5} and Black Carbon from Commercial/Residential/Institutional Sources (2013 to 2020)

Sector	PM _{2.5} from combustion (tonnes)								Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020	2013	2014	2015	2016	2017	2018	2019	2020
Commercial and Institutional Fuel Combustion	2 300	2 400	2 300	2 400	2 600	2 700	2 900	2 800	830	880	840	900	970	1 000	1 100	1 000
Construction Fuel Combustion	120	120	120	120	120	130	130	130	42	41	41	43	44	47	48	47
Home Firewood Burning	89 000	89 000	85 000	79 000	77 000	85 000	87 000	80 000	8 000	8 000	7 700	7 200	7 200	7 600	7 400	6 800
Fireplaces	16 000	16 000	14 000	13 000	13 000	15 000	16 000	15 000	900	870	800	730	700	830	910	850
Furnaces	37 000	37 000	36 000	34 000	35 000	35 000	32 000	29 000	5 100	5 100	4 900	4 700	4 800	4 800	4 400	4 000
Wood Stoves	37 000	36 000	35 000	31 000	30 000	36 000	39 000	36 000	2 000	2 000	1 900	1 700	1 600	2 000	2 200	2 000
Residential Fuel Combustion	2 400	2 400	2 300	2 100	2 300	2 500	2 300	2 200	160	160	150	140	150	160	150	140
TOTAL	94 000	94 000	90 000	83 000	82 000	90 000	92 000	85 000	9 000	9 100	8 700	8 300	8 300	8 800	8 700	8 000

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

2.8. Provincial and Territorial Black Carbon Emissions Trends

This section describes black carbon emissions trends by Canadian provinces and territories for 2013 to 2020. Complete provincial and territorial estimates are provided in Annex 4.

Since 2013, black carbon emission trends in Canadian provinces and territories are mostly consistent with the national trend (Figure 2–1), with decreasing emissions, except for Prince Edward Island where emissions increased by 20 t or 12%. According to the Table 2–9, the most significant reduction in total emissions in mass units between 2013 and 2020 occurred in Ontario (2.1 kt or 25%) followed by Quebec (1.6 kt or 22%) and Alberta (1.4 kt or 20%). Percentage reduction is most noticeable in New Brunswick and Yukon (56% each).

The full-time series of national, provincial, and territorial black carbon emissions from 2013 to 2020 are also available online on the Government of Canada Open Data Portal.³

Table 2–9 Emissions of Black Carbon from Canadian Provinces and Territories (2013 to 2020)

Province/Territories	Black Carbon (tonnes)								2013–2020 trend
	2013	2014	2015	2016	2017	2018	2019	2020	
Alberta	7 300	7 100	6 300	5 400	6 000	6 200	6 200	5 800	-20%
British Columbia	4 300	4 000	3 400	3 200	3 400	3 700	3 800	3 600	-15%
Manitoba	1 400	1 400	1 200	1 200	1 300	1 300	1 300	1 200	-19%
New Brunswick	1 400	1 400	1 400	1 000	750	730	650	600	-56%
Newfoundland and Labrador	910	920	770	800	820	950	980	870	-4%
Nova Scotia	1 300	1 200	1 100	990	1 000	1 100	1 000	900	-29%
Northwest Territories	440	400	390	330	360	370	320	300	-32%
Nunavut	150	110	110	120	220	92	150	110	-28%
Ontario	8 200	7 500	7 100	6 300	6 600	7 000	7 000	6 100	-25%
Prince Edward Island	170	150	130	150	180	200	220	190	12%
Quebec	7 500	7 200	6 800	6 200	6 200	6 500	6 600	5 900	-22%
Saskatchewan	4 100	4 100	3 900	3 200	3 400	3 600	3 500	3 400	-17%
Yukon	61	34	31	30	30	29	32	26	-56%
CANADA	37 000	36 000	33 000	29 000	30 000	32 000	32 000	29 000	-22%

Notes:

Totals may not add up due to rounding.

Values in this report have been rounded to two significant digits.

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

BLACK CARBON INVENTORY DEVELOPMENT

As mentioned in the introduction, the black carbon (BC) inventory is based on the Air Pollutant Emissions Inventory (APEI) (Environment and Climate Change Canada [ECCC], 2022). This chapter gives an overview of the development of the black carbon inventory. For more details on the air pollutant emissions inventory development, refer to Chapter 3 of the APEI.

3.1. Methodology – Black Carbon as a Fraction of Particulate Matter Less Than or Equal to 2.5 Microns in Diameter

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 most sources, the basis for the black carbon inventory is the $PM_{2.5}$ emitted from combustion processes, 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 can be 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 highly effective $PM_{2.5}$ controls on boiler emissions, with PM-control efficiencies often in the 90% range. This is reflected in the lower $PM_{2.5}$ emissions compared with other sources. In contrast, the smaller and markedly different equipment used for residential wood combustion (fireplaces, wood stoves or furnaces) have poorer $PM_{2.5}$ 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 by far the largest source of combustion-related $PM_{2.5}$ emissions in Canada. Nonetheless, black carbon emissions from residential wood burning are only slightly more than one third that of mobile sources due to a lower BC/ $PM_{2.5}$ fraction for wood devices than for diesel engines.

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, 2014a) 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. appliance types for residential wood combustion), 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 were used directly with BC/ $PM_{2.5}$ fractions to estimate black carbon emissions. Annex 2 lists all BC/ $PM_{2.5}$ fractions used in this inventory. Separating combustion from non-combustion sources of $PM_{2.5}$ remains a challenge in some cases because of a lack of data on activities (i.e. quantity of fuel burned) and on 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 on the basis of expert knowledge of the relevant activities prior to applying BC/ $PM_{2.5}$ fractions.

To estimate emissions from mobile sources, bottom-up approaches were 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, $PM_{2.5}$ was estimated first, and BC/ $PM_{2.5}$ fractions were subsequently applied. The methods for estimating $PM_{2.5}$ emissions from mobile sources are described in the APEI Report (ECCC, 2022).

3.2. Use of Facility Reported Emissions

Only PM_{2.5} emissions resulting from combustion contain significant amounts of black carbon. In the APEI, PM_{2.5} emission estimates are calculated using a variety of data sources, notably emission estimates reported by Canadian facilities to the National Pollutant Release Inventory (NPRI). For sources that are incompletely covered by PM_{2.5} estimates reported to the NPRI, PM_{2.5} emissions are calculated in-house using activity data, statistics 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, 2019). Emissions due to agricultural, construction and residential (wood and other) fuel combustion are estimated from data on fuel consumption and combustion technologies. Commercial Fuel Combustion is estimated using a combination of facility-reported and other data sources.

Stack emissions of PM_{2.5} reported by facilities form the basis of black carbon estimates from facility-reported data. For each individual stack, the appropriate black carbon speciation factor (or factors) was applied to the combustion-related PM_{2.5} (Annex 2). The emissions are then summed at the facility level and aggregated to form the sectoral emission estimate.

3.3. Recalculations

As new data and methodologies become available, emission estimates from previous inventory editions are recalculated. Table 3–1 presents the main improvements to the estimation methodologies for this year’s inventory.

Description	Impact on Emissions
ORE AND MINERAL INDUSTRIES	
Recalculations occurred in the Aluminium Industry sector for years 2013 to 2019 as a result of revised facility reporting of PM _{2.5} emissions in the Aluminium Industry sector and a better understanding of processes in these sectors, allowing for more accurate assignment of speciation factors.	Recalculations in the Aluminium Industry sector occurred for all years of the time series, ranging from a maximum decrease of 0.95 tonnes (2.1%) in 2014 to a maximum increase of 0.28 tonnes (0.55%) in 2013.
OIL AND GAS INDUSTRY	
Recalculations occurred due to updates to the methodology used to estimate flaring emissions from oil and gas operations in Saskatchewan. The updated methodology uses operator reported volumes of flared gas (SK MER, 2013-2020) and gas composition data by production class provided by the Saskatchewan Ministry of Energy and Resources (SK MER, 2021) allowing the updated methodology to reflect regional variability within the province. Using the gas composition data, the higher heating value (HHV) is calculated for each production class, enabling the direct estimation of black carbon emissions using the empirical relationship between HHV and black carbon emissions established by the Quadram study (2019). This methodology is used to estimate black carbon emissions from flaring in Saskatchewan for the following oil and gas sectors: Natural Gas Production and Processing, Light/Medium Crude Oil Production, Heavy Crude Oil Cold Production and In-situ Oil Sands Production.	These recalculations resulted in upward revisions to emissions for the oil and gas sector in all years (from 2013 to 2019), with the changes ranging from 330 tonnes (14.5%) in 2019 to 649 tonnes (26.4%) in 2014.
MANUFACTURING	
Recalculations occurred in the Pulp and Paper Industry sector and Wood Products sector for years 2016 to 2019 as a result of revised facility reporting of PM _{2.5} emissions.	Recalculations in the Pulp and Paper Industry sector and Wood Products sector ranged from a maximum decrease of 1.3 tonnes (0.72%) in 2016 to a maximum increase of 23 tonnes (15%) in 2019.
TRANSPORTATION AND MOBILE EQUIPMENT – RAIL	
Recalculations occurred in the rail transportation sector. Provincial activity data was updated to reflect the amount of fuel consumed within a geographical region whereas the previous model was based on fuel supplied to a geographical region.	The recalculations to the rail model did not significantly affect the national number but reallocated fuel between provinces resulting in significant provincial recalculations.
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL – HOME FIREWOOD BURNING	
Recalculations occurred in the commercial/institutional and residential sector in all years back to 2013. Recalculations occurred due to updated fuel consumption data in the Report on Energy Supply and Demand in Canada, and the Households and the Environment Survey.	The recalculations resulted in changes ranging from -7 kt in 2015 to 166 kt in 2018. The recalculations for 2019 resulted in an increase of 62 kt.

3.4. Sources of Uncertainty

A key source of uncertainty associated with black carbon inventories is the inconsistencies 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. Similarly, a single BC/PM_{2.5} fraction is applied to all residential wood combustion appliances except wood furnaces (Annex 3, Table A3–1). 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 stack names), with varying degrees of accuracy.

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 not broken down between combustion and non-combustion emissions. For some sectors (such as Aluminium, Pulp and Paper, and Cement and Concrete industries), it is assumed that the PM_{2.5} emissions are combustion-related when emissions of both CO and NO_x are reported from the same stack; this assumption contributes to the overall uncertainty.

3.5. Considerations for Future Editions of this Inventory

Future improvements will focus on expanding current coverage, as well as improving the accuracy of emission estimates, including 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.
- Explore incorporating emissions from missing industrial sectors, such as Non-Ferrous Refining and Smelting and the Chemicals Industry.

SECTOR DESCRIPTIONS

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

ORE AND MINERAL INDUSTRIES	
Aluminium Industry	Alumina production through bauxite refining, primary aluminium production through smelting and refining 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 and concrete batching and products.
Foundries ^a	Castings of various types of ferro-alloys as well as small iron and steel foundries not associated with integrated iron and steel facilities. The types of foundries included are open ferrous, electric arc and induction foundries.
Iron and Steel Industry	Steel production, including blast furnaces, basic oxygen furnaces, electric arc furnaces, sintering, direct reduction of iron, hot forming and semi-finishing, and coke production.
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.
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	An open flame used for routine or emergency disposal of waste gas.
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 (25° 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 25° 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 ₂ S 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.
Oil Sands In-Situ 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/Service/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 sale and/or private use.
Diesel	Electric power generation from combustion of diesel by utilities (both publicly and privately owned) for commercial sale and/or private use.
Natural Gas	Electric power generation from combustion of natural gas by utilities (both publicly and privately owned) for commercial sale and/or private use.
Other (Electric Power Generation)	Electric power generation from other energy sources by utilities (both publicly and privately owned) for commercial sale and/or private use.

Table A1-1 **Sector Descriptions** (cont'd)

MANUFACTURING	
Pulp and Paper Industry	Chemical, mechanical, recycling and semi-chemical 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.
International Air Transportation (Cruise)	Cruise modes from aircraft used for international commercial and private operations.
Domestic Marine Navigation, Fishing and Military	Marine vessels engaged in domestic navigation, fishing, or military operations within Canadian waters.
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 and Natural Gas	Off-road vehicles and mobile equipment using gasoline and compressed natural gas in mining, construction, agriculture, logging, railway maintenance, airport ground support and for commercial purposes; lawn and garden equipment using gasoline or compressed natural gas; and recreational vehicles using gasoline and compressed natural gas.
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.
Construction Fuel Combustion	Combustion of fossil fuels used for space heating and the heating of construction materials, such as concrete.
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.
Note:	
a. Foundries is being considered for omission from future inventories. If you have any questions, please contact us at apei-iepa@ec.gc.ca or 1-877-877-8375.	

FRACTIONS OF BLACK CARBON TO PARTICULATE MATTER LESS THAN OR EQUAL TO 2.5 MICRONS IN DIAMETER

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The fractions used to convert particulate matter less than or equal to 2.5 microns in diameter (PM_{2.5}) emissions to black carbon (BC) emissions are listed in Table A2-1 through Table A2-7.

Sector	Subsector	BC/PM _{2.5} Fractions		Profile	Reference	
		Description	Value (w/w)			
Aluminium Industry	Alumina (Bauxite Refining)	Aluminium Processing, baghouse (avg)	0.020165	2910110 291012.5 2910130 29101C	Average of 4 speciation factors from U.S. EPA (2014a)	
		Primary Aluminum Smelting and Refining	Aluminium Processing, baghouse (avg)	0.020165	2910110 291012.5 2910130 29101C	Average of 4 speciation factors from U.S. EPA (2014a)
	Aluminium Reduction Potline		0.0268	2910210	U.S. EPA (2014a)	
	Average of large stack BC/PM _{2.5} fractions		0.022507	NA	Weighted average	
	Secondary Aluminium Production (Includes Recycling)	Secondary Aluminium – Dross Recovery Furnace		0.0142575	2010310 201032.5 2010330 20103C	U.S. EPA (2014a)
Cement and Concrete Industry	Cement Manufacture	Cement Kiln (Coal-Fired)	0.002	2720310	U.S. EPA (2014a)	
		Cement Kiln	0.027801	4331	U.S. EPA (2014a)	
	Concrete Batching and Products	Sector Specific Speciation Factor – Concrete Batching & Products	0.001704	NA	U.S. EPA (2014a)	
	Gypsum Product Manufacturing	Sector Specific Speciation Factor – Gypsum Product Manufacturing	0.01467	NA	U.S. EPA (2014a)	
	Lime Manufacturing	Lime Kiln	0.00464	23202C	U.S. EPA (2014a)	
Foundries	Die Casting	Cast Iron Cupola – Composite	0.009096	91157	U.S. EPA (2014a)	
	Ferrous Foundries	Cast Iron Cupola – Composite	0.009096	91157	U.S. EPA (2014a)	
		Non-Ferrous Foundries	Primary Metal Production – Average	0.01002	9000730	U.S. EPA (2014a)
Iron and Steel Industry	Primary (Blast Furnace and DRI)	Iron and Steel facility – Coke Making	0.137466	8945	U.S. EPA (2014a)	
		Blast Furnace Charging	0.024	NA	EEA (2019) (2.C.1 Iron and Steel Production, Table 3.9)	
	Secondary (Electric Arc Furnace)	Electric Arc Furnace / Basic Oxygen Furnace – Composite	0.00363	283052.5 3989 3997	Average of 3 speciation factors U.S. EPA (2011) Speciate 4.3	
		Iron and Steel facility – Hot forming	0.023967	8948	U.S. EPA (2014a)	

Table A2-1 Black Carbon/PM_{2.5} Ratios for Ore and Mineral Industries Source Emission Calculations (cont'd)

Sector	Subsector	BC/PM _{2.5} Fractions		Profile	Reference
		Description	Value (w/w)		
Iron Ore Industry	Iron Ore Pelletization	Iron and Steel facility – Sintering	0.008653	8946	U.S. EPA (2014a)
Mining and Rock Quarrying	Coal Mining Industry	Mineral Products – Avg – Simplified	0.01467	92120	U.S. EPA (2014a)
		Metal Mining	Incinerator (avg)	0.06658	3286
			3287		
			3288		
		Diesel Exhaust	0.77124	3914	U.S. EPA (2014a)
		Average of large stack BC/PM _{2.5} fractions	0.06658	3286	U.S. EPA (2014a)
				3287	
			3288		
			3290		
	Potash	Phosphate Manufacturing – Composite	0.0274	91165	U.S. EPA (2014a)
		Average of large stack BC/PM _{2.5} fractions	0.0274	91165	U.S. EPA (2014a)
	Rock, Sand and Gravel	Sand	0.00265	3665	U.S. EPA (2014a)
Mining and Rock Quarrying	Silica Production	Mineral Products – Avg – Simplified	0.01467	92120	U.S. EPA (2014a)
	Limestone	Mineral Products – Avg – Simplified	0.01467	92120	U.S. EPA (2014a)
	Other (Mining and Rock Quarrying)	Mineral Products – Average	0.01537	9001310	U.S. EPA (2014a)
				900132.5	
				9001330	
		Natural Gas Combustion – Simplified	0.384	92112	U.S. EPA (2014a)
		Oil Combustion	0.42997	3864	U.S. EPA (2014a)
	Diesel Exhaust	0.77124	3914	U.S. EPA (2014a)	
	Average of large stack BC/PM _{2.5} fractions	0.13074	NA	Weighted average	

Note:
NA = Not applicable

Table A2-2 Black Carbon/PM_{2.5} Ratios for Oil and Gas Industry Source Emission Calculations

Sector	Subsector	BC/PM _{2.5} Fractions		Profile	Reference																				
		Description	Value (w/w)																						
Disposal and Waste Treatment Natural Gas Transmission and Storage Natural Gas Distribution Oil Sands Mining, Extraction and Upgrading Petroleum Liquids Storage Petroleum Liquids Transportation Well Drilling/Serviceing	Flaring		0.24	NA	McEwen (2012)																				
						Heavy Crude Oil Cold Production Light/Medium Crude Oil Production Natural Gas Production and Processing Oil Sands In-Situ Extraction Well Testing	Flaring	NA	NA	Emission Factors: Quadram (2019) Activity Data: AER (2020); BCOGC (2020; 2021); CNLOPB (2021); Petrinex (2021); SKMER (2021)															
											Heavy Crude Oil Cold Production Light/Medium Crude Oil Production Natural Gas Production and Processing Oil Sands In-Situ Extraction Oil Sands Mining, Extraction and Upgrading Well Drilling/Serviceing/Testing	Diesel Exhaust	0.77124	3914	U.S. EPA (2014a)										
																Disposal and Waste Treatment Heavy Crude Oil Cold Production Light/Medium Crude Oil Production Natural Gas Production and Processing Natural Gas Transmission and Storage Natural Gas Distribution Oil Sands In-Situ Extraction Oil Sands Mining, Extraction and Upgrading Petroleum Liquids Storage Petroleum Liquids Transportation Well Drilling/Serviceing/Testing	Natural Gas Combustion – Simplified	0.384	92112	U.S. EPA (2014a)					
																					Oil Sands Mining, Extraction and Upgrading	Petroleum Coke Combustion	0.0428	91110	U.S. EPA (2014a)
																						Biomass Combustion	0.05579138	92105	U.S. EPA (2014a)

Note:
NA = Not applicable

Table A2-3 **Black Carbon/PM_{2.5} Fractions for Electric Power Generation (Utilities) Source Emission Calculations**

Sector	BC/PM _{2.5} Fractions		Profile	Reference
	Description	Value (w/w)		
Coal	Bituminous Coal Combustion—Simplified	0.01696	92104	U.S. EPA (2014a)
Diesel	Diesel Exhaust	0.77124	92106	U.S. EPA (2014a)
Natural Gas	Gas-Fired Combined Cycle and Cogeneration Plants	0.025	5671	U.S. EPA (2014a)
(Other Electric Power Generation)	Diesel Exhaust ^a	0.77124	92106	U.S. EPA (2014a)
	Distillate Oil Combustion	0.1	4736	U.S. EPA (2014a)
	Flare Gas	0.24	NA	McEwen (2012)
	Gas-Fired Combined Cycle and Cogeneration Plants	0.025	5671	U.S. EPA (2014a)
	Landfill Gas	0.384	91112	U.S. EPA (2014a)
	Oil Combustion	0.429969	3864	U.S. EPA (2014a)
	Residual Oil Combustion	0.01	4737	U.S. EPA (2014a)
	Wood Fired Boiler—Simplified	0.037088024	92114	U.S. EPA (2014a)

Note:

NA = Not applicable

a. This diesel is included as part of other electric power generation since it is the diesel combustion occurring at hydroelectric power plants.

Table A2-4 **Black Carbon/PM_{2.5} Fractions for Manufacturing Source Emission Calculations**

Sector	Subsector	BC/PM _{2.5} Fractions		Profile	Reference
		Description	Value (w/w)		
Pulp and Paper Industry	Pulp and Paper Product Manufacturing	Kraft Recovery Furnace – Simplified	0.0153	92119	U.S. EPA (2014a)
		Wood-Fired Boiler – Simplified	0.03709	92114	U.S. EPA (2014a)
		Residual Oil Combustion	0.01	4737	U.S. EPA (2014a)
		Hog fuel and bunker crude use	0.03167	92114 (80%) 4737 (20%)	U.S. EPA (2014a)
		Natural Gas	0.384	91112	U.S. EPA (2014a)
		Light Fuel Oil	0.1	91115	U.S. EPA (2014a)
		Distillate Oil	0.1	92115	U.S. EPA (2014a)
		Sludge	0.01522	92177	U.S. EPA (2014a)
		Lime Kiln	0.00464	23202C	U.S. EPA (2014a)
		Gas-Fired Combined Cycle and Cogeneration Plants	0.025	5671	U.S. EPA (2014a)
		Oil-Fired Boilers	0.071	5672	U.S. EPA (2014a)
		Average of large stack BC/PM _{2.5} fractions	0.06926	NA	Weighted average
		Average of large stack BC/PM _{2.5} fractions	0.06926	NA	Weighted average
Wood Products	Panel Board Mills	Wood-Fired Boiler – Simplified	0.03709	92114	U.S. EPA (2014a)
		Wood Products – Drying – Composite	0.08	91128	U.S. EPA (2014a)
		Composite wood and natural gas boilers	0.21054	91114 91112	U.S. EPA (2014a)
		Average of large stack BC/PM _{2.5} fractions	0.08553	NA	Weighted average
	Sawmills	Wood-Fired Boiler – Simplified	0.03709	92114	U.S. EPA (2014a)
		Wood Products – Drying – Composite	0.08	91128	U.S. EPA (2014a)
	Other (Wood Products)	Wood-Fired Boiler – Simplified	0.03709	92114	U.S. EPA (2014a)
		Wood Products – Drying – Composite	0.08	91128	U.S. EPA (2014a)
		Average of large stack BC/PM _{2.5} fractions	0.05139	NA	Weighted average

Note:

NA = Not applicable

Table A2–5 Black Carbon/PM_{2.5} Fractions for Transportation and Mobile Equipment Source Emission Calculations

Sector	BC/PM _{2.5} Fractions		Profile	Reference
	Description	Value (w/w)		
Air Transportation (LTO)	Aviation Turbo Fuel (Jet A or B)	0.771241	92106	U.S. EPA (2014a)
Domestic Air Transportation (Cruise)	Aviation Gasoline	0.12178	92113	U.S. EPA (2014a)
International Air Transportation (Cruise)	Diesel	0.771241	92106	U.S. EPA (2014a)
Domestic Marine Navigation, Fishing and Military	Heavy Fuel Oil	0.12	NA	EEA (2019) (Table A2)
International Marine Navigation				
On-Road Transport	Diesel	EC data extracted from MOVES model; values are variable according to model input and vehicle class	NA	U.S. EPA (2014b)
	Gasoline	EC data extracted from MOVES model; values are variable according to model input and vehicle class	NA	U.S. EPA (2014b)
	Liquid Petroleum Gas	EC data extracted from MOVES model; values are variable according to model input and vehicle class	NA	U.S. EPA (2014b)
	Natural Gas	EC data extracted from MOVES model; values are variable according to model input and vehicle class	NA	U.S. EPA (2014b)
Off-Road Transport	Diesel	0.771241	92106	U.S. EPA (2014a)
	Gasoline	0.12178	92113	U.S. EPA (2014a)
	Natural Gas	0.384	92112	U.S. EPA (2014a)
Rail Transportation	Diesel	0.771241	92106	U.S. EPA (2014a)
	Biodiesel	0.771241	92106	U.S. EPA (2014a)

Note:
NA = Not applicable

Table A2–6 Black Carbon/PM_{2.5} Fractions for Agriculture Source Emission Calculations

Sector	BC/PM _{2.5} Fractions		Profile	Reference
	Description	Value (w/w)		
Agricultural Fuel Combustion	Coal	0.239526	91155	U.S. EPA (2014a)
	Kerosene & Stove Oil	0.1	91115	U.S. EPA (2014a)
	Light Fuel Oil	0.1	91115	U.S. EPA (2014a)
	Natural Gas	0.067	91156	U.S. EPA (2014a)
	Natural Gas Liquids	0.067	91156	U.S. EPA (2014a)

Table A2–7 Black Carbon/PM_{2.5} Fractions for Commercial/Residential/Institutional Source Emission Calculations

Sector	Subsector	BC/PM _{2.5} Fractions		Profile	Reference
		Description	Value (w/w)		
Commercial and Institutional Fuel Combustion	NA	Coal	0.01696	92104	U.S. EPA (2014a)
		Heavy Fuel Oil	0.01	91117	U.S. EPA (2014a)
		Kerosene & Stove Oil	0.1	91115	U.S. EPA (2014a)
		Light Fuel Oil	0.1	91115	U.S. EPA (2014a)
		Natural Gas	0.384	91112	U.S. EPA (2014a)
		Natural Gas Liquids	0.384	91112	U.S. EPA (2014a)
Construction Fuel Combustion	NA	Heavy Fuel Oil	0.01	91117	U.S. EPA (2014a)
		Kerosene & Stove Oil	0.1	91115	U.S. EPA (2014a)
		Light Fuel Oil	0.1	91115	U.S. EPA (2014a)
		Natural Gas	0.384	91112	U.S. EPA (2014a)
Home Firewood Burning	Advanced Technology Fireplace	Non-Catalytic	0.055791381	92105	U.S. EPA (2014a)
		With Glass Doors	0.055791381	92105	U.S. EPA (2014a)
		Without Glass Doors	0.055791381	92105	U.S. EPA (2014a)
	Fireplace Insert	Advanced Technology	0.055791381	92105	U.S. EPA (2014a)
		Conventional	0.055791381	92105	U.S. EPA (2014a)
	Pellet Stove	All	0.055791381	92105	U.S. EPA (2014a)
	Wood Furnace	All	0.138	4704	U.S. EPA (2014a)
	Wood Stove	Conventional	0.055791381	92105	U.S. EPA (2014a)
EPA Certified	0.055791381	92105	U.S. EPA (2014a)		
Residential Fuel Combustion	NA	Coal	0.239526	91155	U.S. EPA (2014a)
		Heavy Fuel Oil	0.01	91117	U.S. EPA (2014a)
		Kerosene & Stove Oil	0.1	91115	U.S. EPA (2014a)
		Light Fuel Oil	0.1	91115	U.S. EPA (2014a)
		Natural Gas	0.067	91156	U.S. EPA (2014a)
		Natural Gas Liquids	0.067	91156	U.S. EPA (2014a)

Note:
NA = Not applicable

SUBMISSION TO THE UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE

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. Whereas the black carbon report groups emissions by sectors, the emissions in the UNECE are grouped by combustion sources. The black carbon emissions are reported for all years from 2013 and are submitted to UNECE at the same time than Canada's air pollutant emissions inventory. Table A3-1 is a summary of Canada's black carbon emissions allocated into the associated NFR code.

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

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 categories contribute to Canada's national total. International marine navigation (excluding fishing and military operations) are reported in a separate table in the black carbon inventory report, the Air Pollutant Emissions Inventory (APEI) report 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 categories 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.

Table A3-1 Canadian Black Carbon Emissions by Nomenclature for Reporting Codes for 2022 submission

NFR Aggregation	NFR Code	Long name	BC emissions (kt)							
			2013	2014	2015	2016	2017	2018	2019	2020
A_PublicPower	1A1a	Public electricity and heat production	0.21	0.23	0.24	0.24	0.21	0.22	0.21	0.19
B_Industry	1A1c	Manufacture of solid fuels and other energy industries	1.18	1.31	1.26	1.24	1.31	1.34	1.34	1.23
B_Industry	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.12	0.13	0.13	0.13	0.13	0.14	0.14	0.11
B_Industry	1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.03
B_Industry	1A2d	Stationary combustion in manufacturing industries and construction: Pulp, paper and print	0.27	0.22	0.20	0.18	0.17	0.16	0.17	0.16
B_Industry	1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01
B_Industry	1A2gviii	Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	0.71	0.63	0.62	0.54	0.65	0.54	0.59	0.54
B_Industry	2A5a	Quarrying and mining of minerals other than coal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_OtherStationaryComb	1A4ai	Commercial/institutional: Stationary	0.83	0.88	0.84	0.90	0.97	1.02	1.08	1.05
C_OtherStationaryComb	1A4bi	Residential: Stationary	8.18	8.15	7.81	7.33	7.33	7.76	7.57	6.94
C_OtherStationaryComb	1A4ci	Agriculture/Forestry/Fishing: Stationary	0.06	0.06	0.05	0.05	0.05	0.04	0.05	0.05
D_Fugitive	1B1a	Fugitive emission from solid fuels: Coal mining and handling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D_Fugitive	1B2c	Venting and flaring (oil, gas, combined oil and gas)	1.49	1.77	1.64	1.24	1.29	1.31	1.24	1.23
F_RoadTransport	1A3bi	Road transport: Passenger cars	0.33	0.30	0.29	0.29	0.28	0.28	0.27	0.22
F_RoadTransport	1A3bii	Road transport: Light duty vehicles	0.33	0.33	0.33	0.35	0.36	0.38	0.39	0.35
F_RoadTransport	1A3biii	Road transport: Heavy duty vehicles and buses	7.00	6.33	5.64	5.51	5.81	6.07	6.05	5.64

Table A3-1 **Canadian Black Carbon Emissions by Nomenclature for Reporting Codes for 2022 submission (cont'd)**

NFR Aggregation	NFR Code	Long name	BC emissions (kt)							
			2013	2014	2015	2016	2017	2018	2019	2020
F_RoadTransport	1A3biv	Road transport: Mopeds & motorcycles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G_Shipping	1A3dii	National navigation (shipping)	1.43	1.63	0.73	0.75	0.80	0.86	0.96	0.91
H_Aviation	1A3ai(i)	International aviation LTO (civil)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01
H_Aviation	1A3aii(i)	Domestic aviation LTO (civil)	0.20	0.18	0.18	0.17	0.18	0.20	0.19	0.12
I_Offroad	1A2gvii	Mobile Combustion in manufacturing industries and construction: (please specify in the IIR)	5.91	5.23	5.07	3.77	4.20	4.49	4.36	3.69
I_Offroad	1A3c	Railways	1.90	1.76	1.51	1.35	1.45	1.56	1.58	1.47
I_Offroad	1A3ei	Pipeline Transport	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04
I_Offroad	1A3eii	Other (please specify in the IIR)	0.62	0.55	0.53	0.44	0.47	0.49	0.48	0.43
I_Offroad	1A4aii	Commercial/institutional: Mobile	0.71	0.65	0.66	0.57	0.65	0.68	0.68	0.62
I_Offroad	1A4bii	Residential: Household and gardening (mobile)	0.24	0.23	0.23	0.19	0.20	0.21	0.21	0.20
I_Offroad	1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	5.15	4.76	4.41	3.40	3.60	3.88	3.87	3.67
I_Offroad	1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.12	0.08	0.05	0.05	0.04	0.04	0.04	0.05
I_Offroad	1A5b	Other, Mobile (including military, land based and recreational boats)	0.03	0.03	0.04	0.03	0.03	0.02	0.03	0.03
J_Waste	5C1bi	Industrial waste incineration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL			37	36	33	29	30	32	32	29

Note:

0.00 Indicates emissions were truncated due to rounding.

Other emissions estimated in the black carbon inventory

NFR Aggregation	NFR Code	Long name	BC emissions (kt)							
			2013	2014	2015	2016	2017	2018	2019	2020
O_AviCruise	1A3aii(ii)	Domestic aviation cruise (civil)	0.23	0.22	0.21	0.21	0.23	0.25	0.25	0.14
O_AviCruise	1A3ai(ii)	International aviation cruise (civil)	0.37	0.36	0.37	0.38	0.42	0.48	0.49	0.23
P_IntShipping	1A3di(i)	International maritime navigation	3.16	3.67	1.60	1.57	1.53	1.53	1.64	1.42

PROVINCIAL AND TERRITORIAL BLACK CARBON EMISSIONS ESTIMATES, 2013–2020

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This annex contains summary tables (Table A4–1 to Table A4–13) presenting black carbon emissions by province and territory, by year and sector. Note that provincial and territorial emissions estimates may not add up to the national totals due to rounding.

Provincial and territorial black carbon emission tables are also available in electronic file format online at <https://open.canada.ca>.

Table A4-1 Black Carbon Emissions Summary for Newfoundland and Labrador (2013 to 2020)

Source Category and Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
ORE AND MINERAL INDUSTRIES	58	45	42	44	24	20	31	50
Aluminium Industry	-	-	-	-	-	-	-	-
Cement and Concrete Industry	-	-	-	-	-	-	-	-
Foundries ^a	-	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-	-
Iron Ore Pelletizing	4.0	4.2	4.5	4.6	3.9	3.1	3.6	3.7
Mining and Rock Quarrying	54	41	38	39	20	17	27	46
OIL AND GAS INDUSTRY	87	100	85	84	97	120	110	81
Disposal and Waste Treatment	-	-	-	-	-	-	-	-
Flaring	71	87	73	72	84	110	95	64
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	16	15	12	12	13	13	14	16
Natural Gas Production and Processing	-	-	-	-	-	-	-	-
Natural Gas Transmission and Storage	-	-	-	-	-	-	-	-
Natural Gas Distribution	-	-	-	-	-	-	-	-
Oil Sands In-Situ Extraction	-	-	-	-	-	-	-	-
Oil Sands Mining, Extraction and Upgrading	-	-	-	-	-	-	-	-
Petroleum Liquids Storage	-	-	-	-	-	-	-	-
Petroleum Liquids Transportation	-	-	-	-	-	-	-	-
Well Drilling/Service/Testing	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	25	32	36	51	25	25	21	15
Coal	-	-	-	-	-	-	-	-
Diesel	24	30	35	50	22	23	19	13
Natural Gas	-	-	-	-	-	-	-	-
Other (Electric Power Generation)	0.86	1.3	1.4	1.6	3.0	1.9	2.2	1.8
MANUFACTURING	0.64	0.62	0.81	0.84	1.6	1.6	0.58	0.59
Pulp and Paper Industry	0.64	0.62	0.65	0.64	1.4	1.4	0.33	0.33
Wood Products	-	-	0.16	0.20	0.20	0.23	0.25	0.26
TRANSPORTATION AND MOBILE EQUIPMENT	560	580	450	430	420	470	500	420
Air Transportation (LTO)	12	11	11	12	11	11	11	8.0
Domestic Marine Navigation, Fishing and Military	260	270	140	140	150	160	180	170
On-Road Transport	110	120	110	120	100	110	110	90
Diesel	100	110	100	110	90	98	100	79
Gasoline	11	11	11	11	11	11	11	11
Liquid Petroleum Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	-	-	-	-	-	-	-	-
Off-Road Transport	160	160	180	150	150	180	180	130
Diesel	150	150	170	140	140	170	170	130
Gasoline and Natural Gas	8.6	10	10	8.9	9.7	9.2	8.9	9.5
Rail Transportation	14	10	9.3	8.6	9.1	9.0	12	11
AGRICULTURE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fuel Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	170	160	150	200	250	310	320	310
Commercial and Institutional Fuel Combustion	2.6	2.9	3.0	2.8	2.5	1.9	2.0	1.5
Construction Fuel Combustion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Home Firewood Burning	170	160	150	190	240	310	320	300
Fireplaces	10	8.5	7.0	8.1	8.6	11	11	10
Furnaces	130	120	110	150	190	230	230	210
Wood Stoves	33	31	29	38	49	72	85	83
Residential Fuel Combustion	0.28	0.34	0.29	0.31	0.39	0.38	0.36	0.31
TOTAL	910	920	770	800	820	950	980	870

Notes:
 Totals may not add up due to rounding.
 Values in this report have been rounded to two significant digits.
 a. The Foundries sector is being considered for omission from future inventories. If you have any questions, please contact us at apei-iepa@ec.gc.ca or 1-877-877-8375.
 0.00 Indicates emissions were truncated due to rounding.
 - Indicates no emissions

Other emissions estimated in the black carbon inventory

Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
Domestic Air Transportation (Cruise)	6.8	6.5	6.2	6.1	6.2	6.3	6.9	3.5
International Air Transportation (Cruise)	8.8	8.1	7.7	6.8	6.7	6.9	6.3	4.2
International Marine Navigation	180	210	93	83	71	62	81	83

Table A4-2 Black Carbon Emissions Summary for Prince Edward Island (2013 to 2020)

Source Category and Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
ORE AND MINERAL INDUSTRIES	-	-	-	-	-	-	-	-
Aluminium Industry	-	-	-	-	-	-	-	-
Cement and Concrete Industry	-	-	-	-	-	-	-	-
Foundries ^a	-	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	-	-	-	-	-	-	-	-
OIL AND GAS INDUSTRY	-	-	-	-	-	-	-	-
Disposal and Waste Treatment	-	-	-	-	-	-	-	-
Flaring	-	-	-	-	-	-	-	-
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	-	-	-	-	-	-	-	-
Natural Gas Production and Processing	-	-	-	-	-	-	-	-
Natural Gas Transmission and Storage	-	-	-	-	-	-	-	-
Natural Gas Distribution	-	-	-	-	-	-	-	-
Oil Sands In-Situ Extraction	-	-	-	-	-	-	-	-
Oil Sands Mining, Extraction and Upgrading	-	-	-	-	-	-	-	-
Petroleum Liquids Storage	-	-	-	-	-	-	-	-
Petroleum Liquids Transportation	-	-	-	-	-	-	-	-
Well Drilling/Service/Testing	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coal	-	-	-	-	-	-	-	-
Diesel	-	-	-	-	0.00	0.00	0.00	0.00
Natural Gas	-	-	-	-	-	-	-	-
Other (Electric Power Generation)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MANUFACTURING	-	-	-	-	-	-	-	-
Pulp and Paper Industry	-	-	-	-	-	-	-	-
Wood Products	-	-	-	-	-	-	-	-
TRANSPORTATION AND MOBILE EQUIPMENT	81	85	84	79	79	84	83	67
Air Transportation (LTO)	0.54	0.47	0.45	0.48	0.49	0.47	0.48	0.20
Domestic Marine Navigation, Fishing and Military	18	20	15	14	15	16	17	7.5
On-Road Transport	34	36	37	37	34	36	35	32
Diesel	30	32	34	33	30	32	31	29
Gasoline	3.9	3.5	3.3	3.6	3.8	3.5	3.5	3.2
Liquid Petroleum Gas	-	-	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-	-	-
Off-Road Transport	29	29	32	28	29	32	30	27
Diesel	27	27	30	26	27	30	28	25
Gasoline and Natural Gas	2.0	2.0	1.9	2.0	2.3	2.0	2.0	2.0
Rail Transportation	-	-	-	-	-	-	-	-
AGRICULTURE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fuel Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	88	67	49	75	100	120	130	120
Commercial and Institutional Fuel Combustion	0.38	0.27	0.26	0.13	0.14	0.16	0.19	0.20
Construction Fuel Combustion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Home Firewood Burning	87	67	49	74	100	120	130	120
Fireplaces	3.8	2.4	1.3	1.3	0.80	1.2	2.7	2.9
Furnaces	73	56	41	64	86	100	120	110
Wood Stoves	11	8.3	6.2	9.5	13	15	15	14
Residential Fuel Combustion	0.27	0.22	0.18	0.18	0.19	0.18	0.19	0.18
TOTAL	170	150	130	150	180	200	220	190

Notes:

Totals may not add up due to rounding.

Values in this report have been rounded to two significant digits.

a. The Foundries sector is being considered for omission from future inventories. If you have any questions, please contact us at apei-iepa@ec.gc.ca or 1-877-877-8375.

0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Other emissions estimated in the black carbon inventory

Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
Domestic Air Transportation (Cruise)	0.48	0.52	0.57	0.57	0.73	0.64	0.91	0.20
International Air Transportation (Cruise)	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.00
International Marine Navigation	4.0	4.4	2.6	3.2	2.0	1.3	2.0	1.4

Table A4-3 Black Carbon Emissions Summary for Nova Scotia (2013 to 2020)

Source Category and Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
ORE AND MINERAL INDUSTRIES	1.6	0.26	0.41	0.53	0.92	2.7	1.4	11
Aluminium Industry	-	-	-	-	-	-	-	-
Cement and Concrete Industry	0.49	-	0.41	0.53	0.27	2.0	1.4	1.5
Foundries ^a	-	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	1.1	0.26	-	-	0.65	0.62	0.00	9.5
OIL AND GAS INDUSTRY	24	27	19	14	9.5	8.8	9.7	-
Disposal and Waste Treatment	-	-	-	-	-	-	-	-
Flaring	21	24	17	12	8.3	7.7	8.0	-
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	-	-	-	-	-	-	-	-
Natural Gas Production and Processing	2.7	3.0	2.2	1.6	1.1	1.1	1.7	-
Natural Gas Transmission and Storage	-	-	-	-	-	-	-	-
Natural Gas Distribution	-	-	-	-	-	-	-	-
Oil Sands In-Situ Extraction	-	-	-	-	-	-	-	-
Oil Sands Mining, Extraction and Upgrading	-	-	-	-	-	-	-	-
Petroleum Liquids Storage	-	-	-	-	-	-	-	-
Petroleum Liquids Transportation	-	-	-	-	-	-	-	-
Well Drilling/Service/Testing	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	6.0	5.9	6.5	4.2	4.6	5.0	5.8	6.2
Coal	4.7	3.8	5.0	2.9	3.2	2.9	3.6	3.2
Diesel	-	-	-	-	-	-	-	-
Natural Gas	0.15	0.24	0.40	0.24	0.14	0.20	0.57	0.65
Other (Electric Power Generation)	1.1	1.9	1.1	1.0	1.3	1.9	1.6	2.3
MANUFACTURING	23	23	15	4.3	2.7	4.3	4.3	4.3
Pulp and Paper Industry	20	21	12	1.7	0.00	1.8	1.3	0.10
Wood Products	3.5	2.8	2.7	2.7	2.7	2.6	3.0	4.3
TRANSPORTATION AND MOBILE EQUIPMENT	540	480	380	330	390	430	410	350
Air Transportation (LTO)	5.5	5.0	4.9	5.5	5.6	5.9	5.7	3.1
Domestic Marine Navigation, Fishing and Military	160	160	81	72	98	110	120	99
On-Road Transport	170	140	120	120	120	130	120	110
Diesel	160	130	110	100	110	110	110	100
Gasoline	14	12	14	14	15	15	15	15
Liquid Petroleum Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	-	-	-	-	-	-	-	-
Off-Road Transport	190	170	160	130	160	170	160	130
Diesel	180	150	150	120	140	150	140	110
Gasoline and Natural Gas	13	12	15	14	16	17	16	15
Rail Transportation	10	9.0	8.2	8.3	8.7	8.6	6.9	6.4
AGRICULTURE	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fuel Use	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	690	650	720	630	590	620	570	530
Commercial and Institutional Fuel Combustion	8.1	7.9	9.3	10	13	12	17	16
Construction Fuel Combustion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Home Firewood Burning	680	640	700	620	580	600	550	510
Fireplaces	52	49	53	47	43	39	31	27
Furnaces	490	470	520	460	430	440	400	370
Wood Stoves	130	120	130	120	110	120	120	110
Residential Fuel Combustion	1.3	1.2	1.2	0.98	1.0	1.1	1.1	1.0
TOTAL	1 300	1 200	1 100	990	1 000	1 100	1 000	900

Notes:

Totals may not add up due to rounding.

Values in this report have been rounded to two significant digits.

a. The Foundries sector is being considered for omission from future inventories. If you have any questions, please contact us at apei-iepa@ec.gc.ca or 1-877-877-8375.

0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Other emissions estimated in the black carbon inventory

Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
Domestic Air Transportation (Cruise)	6.8	6.6	6.9	6.7	7.4	8.0	8.1	3.4
International Air Transportation (Cruise)	4.1	3.8	4.1	4.2	4.0	4.5	4.6	3.2
International Marine Navigation	340	390	160	170	180	160	170	150

Table A4-4 Black Carbon Emissions Summary for New Brunswick (2013 to 2020)

Source Category and Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
ORE AND MINERAL INDUSTRIES	1.6	2.3	0.28	0.00	0.00	0.00	1.2	0.36
Aluminium Industry	-	-	-	-	-	-	-	-
Cement and Concrete Industry	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00
Foundries ^a	-	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	1.5	2.2	0.28	0.00	0.00	0.00	1.2	0.35
OIL AND GAS INDUSTRY	0.10	0.10	0.00	0.10	0.00	0.10	0.00	0.00
Disposal and Waste Treatment	-	-	-	-	-	-	-	-
Flaring	0.10	0.10	0.00	0.10	0.00	0.10	0.00	0.00
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	-	-	-	-	-	-	-	-
Natural Gas Production and Processing	-	-	-	-	-	-	-	-
Natural Gas Transmission and Storage	-	-	-	-	-	-	-	-
Natural Gas Distribution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oil Sands In-Situ Extraction	-	-	-	-	-	-	-	-
Oil Sands Mining, Extraction and Upgrading	-	-	-	-	-	-	-	-
Petroleum Liquids Storage	-	-	-	-	-	-	-	-
Petroleum Liquids Transportation	-	-	-	-	-	-	-	-
Well Drilling/Service/Testing	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	2.2	1.0	1.6	1.7	0.64	2.0	0.21	0.26
Coal	0.22	0.11	0.68	0.90	0.28	1.8	0.00	0.10
Diesel	-	-	-	-	-	-	-	-
Natural Gas	2.0	0.87	0.82	0.78	0.34	0.15	0.15	0.13
Other (Electric Power Generation)	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00
MANUFACTURING	29	28	35	24	23	19	23	22
Pulp and Paper Industry	8.8	12	11	8.5	7.5	6.2	6.8	11
Wood Products	21	16	23	16	15	13	16	11
TRANSPORTATION AND MOBILE EQUIPMENT	410	380	320	300	280	280	270	240
Air Transportation (LTO)	4.9	4.3	4.5	4.3	4.3	4.7	4.6	2.8
Domestic Marine Navigation, Fishing and Military	62	64	30	32	37	34	43	42
On-Road Transport	160	140	120	120	110	110	100	89
Diesel	140	130	110	110	92	93	86	77
Gasoline	16	13	15	17	15	15	14	12
Liquid Petroleum Gas	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	-	-	-	-	-	-	-	-
Off-Road Transport	150	140	130	110	110	100	95	86
Diesel	140	130	120	97	94	90	82	74
Gasoline and Natural Gas	15	14	16	15	14	13	13	12
Rail Transportation	30	27	26	25	27	25	25	23
AGRICULTURE	0.40	0.51	0.00	0.00	0.00	0.00	0.00	0.00
Fuel Use	0.40	0.51	0.00	0.00	0.00	0.00	0.00	0.00
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	930	980	1 000	690	440	440	360	330
Commercial and Institutional Fuel Combustion	5.6	6.2	6.2	5.7	5.2	5.7	6.0	5.5
Construction Fuel Combustion	0.00	0.00	0.10	0.00	0.10	0.00	0.00	0.00
Home Firewood Burning	920	980	1 000	680	430	430	350	330
Fireplaces	85	76	65	32	12	7.1	6.3	6.1
Furnaces	630	670	720	490	320	310	240	230
Wood Stoves	210	220	240	160	100	110	100	95
Residential Fuel Combustion	0.70	0.91	1.1	0.68	0.59	0.58	0.53	0.47
TOTAL	1 400	1 400	1 400	1 000	750	730	650	600

Notes:

Totals may not add up due to rounding.

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a. The Foundries sector is being considered for omission from future inventories. If you have any questions, please contact us at apei-iepa@ec.gc.ca or 1-877-877-8375.

0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Other emissions estimated in the black carbon inventory

Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
Domestic Air Transportation (Cruise)	3.3	3.2	3.2	3.1	3.1	3.4	3.5	1.7
International Air Transportation (Cruise)	0.57	0.68	0.75	0.48	0.46	0.78	0.83	0.44
International Marine Navigation	99	110	48	46	48	46	49	41

Table A4-5 Black Carbon Emissions Summary for Quebec (2013 to 2020)

Source Category and Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
ORE AND MINERAL INDUSTRIES	98	91	80	74	83	95	96	87
Aluminium Industry	45	41	33	34	33	29	26	29
Cement and Concrete Industry	1.4	2.7	4.6	0.86	1.5	5.0	2.0	1.8
Foundries ^a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron and Steel Industry	2.6	6.8	4.3	3.2	4.5	9.8	9.6	8.0
Iron Ore Pelletizing	2.3	2.3	2.6	2.7	2.4	2.7	2.9	1.8
Mining and Rock Quarrying	47	38	35	33	42	48	55	47
OIL AND GAS INDUSTRY	2.2	2.1	2.2	2.3	2.4	2.3	2.4	2.1
Disposal and Waste Treatment	-	-	-	-	-	-	-	-
Flaring	-	-	-	-	-	-	-	-
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	-	-	-	-	-	-	-	-
Natural Gas Production and Processing	-	-	-	-	-	-	-	-
Natural Gas Transmission and Storage	0.18	0.17	0.17	0.16	0.16	0.16	0.16	0.16
Natural Gas Distribution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oil Sands In-Situ Extraction	-	-	-	-	-	-	-	-
Oil Sands Mining, Extraction and Upgrading	-	-	-	-	-	-	-	-
Petroleum Liquids Storage	-	-	-	-	-	-	-	-
Petroleum Liquids Transportation	2.0	1.9	2.0	2.1	2.2	2.1	2.2	1.9
Well Drilling/Service/Testing	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	44	47	49	47	46	47	47	47
Coal	-	-	-	-	-	-	-	-
Diesel	22	23	24	24	24	25	24	25
Natural Gas	0.10	0.10	0.10	0.10	0.00	0.00	0.00	0.00
Other (Electric Power Generation)	21	24	24	22	21	22	23	22
MANUFACTURING	120	100	95	78	65	63	90	61
Pulp and Paper Industry	82	64	54	48	48	46	64	43
Wood Products	36	41	41	30	16	17	26	17
TRANSPORTATION AND MOBILE EQUIPMENT	3 700	3 300	3 000	2 800	3 000	3 000	3 000	2 700
Air Transportation (LTO)	32	30	29	28	30	33	32	21
Domestic Marine Navigation, Fishing and Military	380	430	190	200	210	220	260	260
On-Road Transport	1 400	1 300	1 200	1 200	1 300	1 300	1 300	1 200
Diesel	1 300	1 200	1 100	1 100	1 200	1 200	1 200	1 100
Gasoline	110	100	100	100	110	110	110	110
Liquid Petroleum Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Off-Road Transport	1 700	1 500	1 500	1 200	1 400	1 300	1 300	1 100
Diesel	1 600	1 400	1 400	1 100	1 300	1 200	1 200	1 000
Gasoline and Natural Gas	92	89	90	77	84	88	88	83
Rail Transportation	110	100	87	80	83	110	110	110
AGRICULTURE	1.1	1.1	1.1	1.2	1.0	1.0	1.1	0.90
Fuel Use	1.1	1.1	1.1	1.2	1.0	1.0	1.1	0.90
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	3 500	3 600	3 600	3 300	3 000	3 300	3 300	3 000
Commercial and Institutional Fuel Combustion	110	120	120	130	130	120	120	110
Construction Fuel Combustion	13	13	12	13	13	15	15	14
Home Firewood Burning	3 400	3 500	3 400	3 100	2 900	3 100	3 200	2 900
Fireplaces	390	400	390	350	330	470	580	540
Furnaces	1 800	1 900	1 900	1 700	1 600	1 600	1 400	1 200
Wood Stoves	1 200	1 200	1 100	1 000	930	1 100	1 200	1 100
Residential Fuel Combustion	6.3	6.3	6.2	6.5	6.4	6.7	7.2	6.3
TOTAL	7 500	7 200	6 800	6 200	6 200	6 500	6 600	5 900

Notes:

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a. The Foundries sector is being considered for omission from future inventories. If you have any questions, please contact us at apei-iepa@ec.gc.ca or 1-877-877-8375.

0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Other emissions estimated in the black carbon inventory

Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
Domestic Air Transportation (Cruise)	23	21	21	21	23	26	27	18
International Air Transportation (Cruise)	61	59	60	62	67	79	88	39
International Marine Navigation	1 100	1 300	550	510	470	460	550	580

Table A4-6 Black Carbon Emissions Summary for Ontario (2013 to 2020)

Source Category and Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
ORE AND MINERAL INDUSTRIES	180	180	170	150	160	170	160	140
Aluminium Industry	-	-	-	-	-	-	-	-
Cement and Concrete Industry	9.2	8.8	9.8	11	11	10	11	6.6
Foundries ^a	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00
Iron and Steel Industry	110	120	120	120	120	130	120	99
Iron Ore Pelletizing	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	53	54	43	28	30	29	27	37
OIL AND GAS INDUSTRY	16	15	16	13	14	15	15	13
Disposal and Waste Treatment	-	-	-	-	-	-	-	-
Flaring	7.3	6.1	6.3	4.3	4.7	5.6	5.4	4.5
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas Production and Processing	1.8	1.5	1.6	1.0	1.1	1.2	1.2	1.0
Natural Gas Transmission and Storage	6.0	7.1	7.2	7.2	7.3	7.3	7.2	7.1
Natural Gas Distribution	0.15	0.16	0.16	0.17	0.17	0.16	0.16	0.16
Oil Sands In-Situ Extraction	-	-	-	-	-	-	-	-
Oil Sands Mining, Extraction and Upgrading	-	-	-	-	-	-	-	-
Petroleum Liquids Storage	0.54	0.43	0.41	0.41	0.44	0.83	0.83	0.68
Petroleum Liquids Transportation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Well Drilling/Service/Testing	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	27	27	23	26	18	20	20	19
Coal	2.3	0.10	-	-	-	-	-	-
Diesel	13	16	12	12	10	13	14	14
Natural Gas	6.0	5.5	5.0	4.5	3.5	3.6	3.2	3.1
Other (Electric Power Generation)	5.1	5.3	6.1	9.2	4.0	3.7	3.2	2.2
MANUFACTURING	79	75	81	75	76	67	78	83
Pulp and Paper Industry	35	31	30	29	31	27	27	29
Wood Products	44	43	52	46	45	41	51	53
TRANSPORTATION AND MOBILE EQUIPMENT	5 700	5 000	4 700	4 000	4 200	4 400	4 300	3 700
Air Transportation (LTO)	57	50	51	52	53	58	55	32
Domestic Marine Navigation, Fishing and Military	69	70	37	35	37	38	32	24
On-Road Transport	2 000	1 700	1 500	1 500	1 500	1 600	1 600	1 400
Diesel	1 700	1 500	1 300	1 200	1 300	1 400	1 300	1 200
Gasoline	240	230	220	230	220	230	240	200
Liquid Petroleum Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Off-Road Transport	3 000	2 600	2 700	2 000	2 200	2 400	2 300	1 900
Diesel	2 900	2 400	2 500	1 900	2 000	2 200	2 100	1 700
Gasoline and Natural Gas	190	190	190	160	170	170	170	150
Rail Transportation	530	520	440	370	400	390	380	350
AGRICULTURE	8.5	6.5	5.4	5.4	4.8	5.0	5.5	5.3
Fuel Use	8.5	6.5	5.4	5.4	4.8	5.0	5.5	5.3
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	2 200	2 300	2 100	2 000	2 100	2 300	2 400	2 200
Commercial and Institutional Fuel Combustion	360	400	380	390	410	440	480	490
Construction Fuel Combustion	10	9.8	9.4	9.7	8.8	9.0	9.8	9.4
Home Firewood Burning	1 800	1 800	1 600	1 500	1 600	1 800	1 800	1 700
Fireplaces	260	250	220	210	210	200	170	160
Furnaces	1 200	1 200	1 100	1 000	1 100	1 200	1 300	1 200
Wood Stoves	360	360	320	310	310	360	360	320
Residential Fuel Combustion	77	77	78	71	74	86	73	66
TOTAL	8 200	7 500	7 100	6 300	6 600	7 000	7 000	6 100

Notes:

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0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Other emissions estimated in the black carbon inventory

Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
Domestic Air Transportation (Cruise)	69	65	67	69	73	79	81	40
International Air Transportation (Cruise)	160	150	160	170	190	220	230	100
International Marine Navigation	120	140	81	82	65	60	60	48

Table A4-7 Black Carbon Emissions Summary for Manitoba (2013 to 2020)

Source Category and Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
ORE AND MINERAL INDUSTRIES	0.24	0.23	0.25	0.23	0.54	0.51	0.50	0.39
Aluminium Industry	-	-	-	-	-	-	-	-
Cement and Concrete Industry	0.20	0.18	0.21	0.19	0.21	0.21	0.19	0.20
Foundries ^a	-	-	-	-	-	-	-	-
Iron and Steel Industry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron Ore Pelletizing	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	-	0.00	0.00	0.00	0.29	0.27	0.27	0.16
OIL AND GAS INDUSTRY	32	31	29	27	25	29	31	24
Disposal and Waste Treatment	-	-	-	-	-	-	-	-
Flaring	31	30	28	26	24	26	27	23
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	0.39	0.38	0.35	0.33	0.30	0.33	0.34	0.29
Natural Gas Production and Processing	-	-	-	-	-	-	-	-
Natural Gas Transmission and Storage	0.13	0.26	0.42	0.26	0.16	0.41	0.44	0.16
Natural Gas Distribution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oil Sands In-Situ Extraction	-	-	-	-	-	-	-	-
Oil Sands Mining, Extraction and Upgrading	-	-	-	-	-	-	-	-
Petroleum Liquids Storage	0.00	0.12	0.00	0.00	0.93	3.0	3.0	0.36
Petroleum Liquids Transportation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Well Drilling/Service/Testing	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	2.7	2.8	3.0	2.8	2.7	2.8	2.7	2.9
Coal	-	-	-	-	-	-	-	-
Diesel	2.5	2.6	2.8	2.7	2.7	2.7	2.6	2.9
Natural Gas	0.17	0.15	0.23	0.10	0.10	0.00	0.00	0.00
Other (Electric Power Generation)	-	-	-	-	-	-	-	-
MANUFACTURING	14	12	10	15	14	15	14	14
Pulp and Paper Industry	14	11	10	15	14	14	11	12
Wood Products	0.72	0.64	0.39	0.60	0.68	0.88	2.2	2.7
TRANSPORTATION AND MOBILE EQUIPMENT	1 100	1 100	930	880	940	980	950	890
Air Transportation (LTO)	17	15	15	15	16	17	17	14
Domestic Marine Navigation, Fishing and Military	1.1	0.62	0.24	0.00	0.29	0.83	0.53	0.23
On-Road Transport	300	310	260	290	320	330	320	310
Diesel	250	260	210	240	270	280	270	270
Gasoline	55	50	46	47	46	49	48	44
Liquid Petroleum Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	-	-	-	-	-	-	-	-
Off-Road Transport	630	610	530	460	490	500	480	450
Diesel	610	590	510	440	470	480	460	430
Gasoline and Natural Gas	20	22	21	18	18	21	20	20
Rail Transportation	160	150	130	110	120	130	130	120
AGRICULTURE	0.11	0.10	0.10	0.10	0.10	0.12	0.12	0.13
Fuel Use	0.11	0.10	0.10	0.10	0.10	0.12	0.12	0.13
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	270	270	240	250	280	290	260	230
Commercial and Institutional Fuel Combustion	43	46	41	40	43	47	49	46
Construction Fuel Combustion	5.2	4.7	4.5	5.0	4.3	4.8	4.8	4.6
Home Firewood Burning	220	220	190	200	230	230	200	180
Fireplaces	7.0	6.8	5.8	6.1	6.9	12	16	15
Furnaces	200	200	180	190	220	180	110	82
Wood Stoves	8.4	7.7	6.1	6.0	6.1	41	78	79
Residential Fuel Combustion	5.0	5.0	4.2	4.4	4.6	4.9	4.9	4.7
TOTAL	1 400	1 400	1 200	1 200	1 300	1 300	1 300	1 200

Notes:
 Totals may not add up due to rounding.
 Values in this report have been rounded to two significant digits.
 a. The Foundries sector is being considered for omission from future inventories. If you have any questions, please contact us at apei-iepa@ec.gc.ca or 1-877-877-8375.
 0.00 Indicates emissions were truncated due to rounding.
 - Indicates no emissions

Other emissions estimated in the black carbon inventory

Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
Domestic Air Transportation (Cruise)	13	13	12	12	13	14	14	8.8
International Air Transportation (Cruise)	3.3	3.1	3.1	3.2	3.2	3.3	3.5	2.3
International Marine Navigation	4.0	3.2	2.0	0.00	0.10	0.14	0.96	1.8

Table A4-8 Black Carbon Emissions Summary for Saskatchewan (2013 to 2020)

Source Category and Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
ORE AND MINERAL INDUSTRIES	30	22	21	23	19	22	22	19
Aluminium Industry	-	-	-	-	-	-	-	-
Cement and Concrete Industry	-	-	-	0.00	-	-	-	-
Foundries ^a	-	-	-	-	-	-	-	-
Iron and Steel Industry	0.10	0.20	0.11	0.10	0.17	0.14	0.12	0.14
Iron Ore Pelletizing	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	30	21	21	23	19	22	22	19
OIL AND GAS INDUSTRY	860	1 000	970	750	720	720	650	620
Disposal and Waste Treatment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Flaring	810	980	930	710	690	680	620	580
Heavy Crude Oil Cold Production	10	10	11	9.2	9.2	8.9	8.5	6.6
Light/Medium Crude Oil Production	5.7	3.4	3.7	3.8	3.6	3.9	3.3	2.8
Natural Gas Production and Processing	15	15	15	15	15	15	15	13
Natural Gas Transmission and Storage	7.2	6.3	6.3	6.3	6.3	6.3	6.2	6.2
Natural Gas Distribution	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Oil Sands In-Situ Extraction	1.3	0.95	0.88	0.96	0.60	1.4	1.5	0.97
Oil Sands Mining, Extraction and Upgrading	4.6	2.3	3.6	2.3	2.1	1.9	3.2	3.5
Petroleum Liquids Storage	-	-	-	-	-	-	-	-
Petroleum Liquids Transportation	-	-	-	-	-	-	-	-
Well Drilling/Service/Testing	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	5.3	5.2	6.1	5.9	6.1	13	9.9	9.5
Coal	3.7	3.7	3.8	3.7	3.6	11	8.6	7.9
Diesel	-	-	0.45	0.36	0.39	0.39	0.38	0.37
Natural Gas	1.6	1.5	1.8	1.8	2.1	2.1	0.94	1.2
Other (Electric Power Generation)	-	-	-	-	-	0.00	0.00	0.00
MANUFACTURING	28	3.4	4.3	4.4	4.4	4.7	4.5	4.6
Pulp and Paper Industry	0.32	0.29	0.13	0.00	0.00	0.17	0.00	0.00
Wood Products	27	3.1	4.2	4.3	4.4	4.5	4.5	4.6
TRANSPORTATION AND MOBILE EQUIPMENT	3 000	2 900	2 700	2 300	2 500	2 700	2 600	2 600
Air Transportation (LTO)	13	12	11	10	9.8	10	9.6	6.6
Domestic Marine Navigation, Fishing and Military	-	-	-	-	-	-	-	-
On-Road Transport	620	630	580	570	610	640	620	610
Diesel	500	540	480	470	510	540	520	530
Gasoline	120	95	97	100	99	96	95	85
Liquid Petroleum Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Off-Road Transport	2 100	2 100	1 900	1 500	1 700	1 800	1 800	1 700
Diesel	2 100	2 000	1 900	1 500	1 600	1 800	1 700	1 700
Gasoline and Natural Gas	30	29	30	25	25	23	23	22
Rail Transportation	240	220	200	180	190	220	220	210
AGRICULTURE	0.56	0.63	0.73	0.56	0.70	0.70	0.53	0.55
Fuel Use	0.56	0.63	0.73	0.56	0.70	0.70	0.53	0.55
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	140	130	120	140	160	180	180	170
Commercial and Institutional Fuel Combustion	36	37	36	44	48	53	55	50
Construction Fuel Combustion	1.3	1.5	1.8	1.3	1.7	1.7	1.3	1.3
Home Firewood Burning	89	85	71	84	110	120	110	110
Fireplaces	4.8	5.3	5.0	6.5	9.2	7.0	4.2	4.2
Furnaces	80	76	63	74	94	100	100	96
Wood Stoves	4.2	3.9	3.1	3.5	4.3	6.2	7.5	7.1
Residential Fuel Combustion	10	9.8	8.4	7.9	7.7	8.5	8.9	8.0
TOTAL	4 100	4 100	3 900	3 200	3 400	3 600	3 500	3 400

Notes:

Totals may not add up due to rounding.

Values in this report have been rounded to two significant digits.

a. The Foundries sector is being considered for omission from future inventories. If you have any questions, please contact us at apei-iepa@ec.gc.ca or 1-877-877-8375.

0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Other emissions estimated in the black carbon inventory

Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
Domestic Air Transportation (Cruise)	6.0	6.0	5.9	5.5	5.7	6.1	5.9	2.9
International Air Transportation (Cruise)	2.5	2.4	2.1	2.0	1.8	1.7	1.5	0.72
International Marine Navigation	-	-	-	-	-	-	-	-

Table A4-9 Black Carbon Emissions Summary for Alberta (2013 to 2020)

Source Category and Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
ORE AND MINERAL INDUSTRIES	3.2	3.4	3.2	1.3	1.5	1.0	2.5	2.5
Aluminium Industry	-	-	-	-	-	-	-	-
Cement and Concrete Industry	1.1	1.5	2.8	1.0	1.2	0.82	0.69	0.76
Foundries ^a	-	-	-	-	-	-	-	-
Iron and Steel Industry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron Ore Pelletizing	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	2.1	1.8	0.38	0.24	0.22	0.22	1.8	1.7
OIL AND GAS INDUSTRY	1 500	1 700	1 600	1 500	1 600	1 600	1 600	1 600
Disposal and Waste Treatment	0.10	0.11	0.11	0.10	0.10	0.10	0.10	0.10
Flaring	460	530	480	340	400	400	420	490
Heavy Crude Oil Cold Production	84	86	88	86	88	92	91	82
Light/Medium Crude Oil Production	130	130	130	130	130	140	140	120
Natural Gas Production and Processing	410	420	420	410	420	420	420	380
Natural Gas Transmission and Storage	12	13	13	16	16	16	17	18
Natural Gas Distribution	0.46	0.37	0.32	0.32	0.34	0.33	0.31	0.10
Oil Sands In-Situ Extraction	180	190	210	210	230	250	260	220
Oil Sands Mining, Extraction and Upgrading	200	310	250	250	290	280	270	280
Petroleum Liquids Storage	2.9	2.5	2.6	2.2	0.99	1.0	3.9	2.3
Petroleum Liquids Transportation	1.1	1.2	1.3	1.4	1.4	1.5	1.5	1.5
Well Drilling/Service/Testing	3.0	2.9	1.3	0.89	1.4	1.4	1.1	0.62
ELECTRIC POWER GENERATION (UTILITIES)	35	42	38	38	39	27	24	21
Coal	26	34	30	29	30	21	18	14
Diesel	4.8	4.9	5.1	5.2	6.0	2.3	2.7	3.6
Natural Gas	2.0	2.0	2.0	2.0	2.2	2.3	1.9	2.2
Other (Electric Power Generation)	1.4	1.3	1.3	1.2	1.2	1.2	1.3	1.1
MANUFACTURING	84	50	76	35	24	25	24	33
Pulp and Paper Industry	32	16	18	22	11	12	9.9	9.6
Wood Products	53	34	58	13	14	13	14	23
TRANSPORTATION AND MOBILE EQUIPMENT	5 200	4 900	4 200	3 300	3 600	3 900	3 900	3 700
Air Transportation (LTO)	33	31	29	26	27	30	29	17
Domestic Marine Navigation, Fishing and Military	0.00	0.00	-	-	0.10	-	-	-
On-Road Transport	1 700	1 600	1 400	1 200	1 400	1 400	1 400	1 400
Diesel	1 500	1 500	1 200	1 100	1 200	1 300	1 300	1 200
Gasoline	160	160	140	150	150	160	160	130
Liquid Petroleum Gas	0.12	0.00	0.00	0.00	0.10	0.10	0.10	0.10
Natural Gas	0.00	0.00	0.00	0.11	0.36	0.36	0.32	0.40
Off-Road Transport	3 200	2 900	2 600	1 800	2 000	2 200	2 200	2 000
Diesel	3 200	2 900	2 500	1 800	1 900	2 100	2 200	2 000
Gasoline and Natural Gas	62	69	65	60	61	63	63	59
Rail Transportation	300	270	230	220	240	250	250	230
AGRICULTURE	34	35	33	32	31	25	23	16
Fuel Use	34	35	33	32	31	25	23	16
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	380	370	320	510	760	660	520	500
Commercial and Institutional Fuel Combustion	180	190	170	190	230	250	250	240
Construction Fuel Combustion	9.7	9.8	10	11	12	13	14	13
Home Firewood Burning	160	140	110	280	490	360	220	210
Fireplaces	12	9.7	7.0	17	28	34	30	30
Furnaces	130	120	91	240	420	290	160	150
Wood Stoves	10	9.4	7.4	20	37	36	28	29
Residential Fuel Combustion	40	38	35	30	35	37	36	36
TOTAL	7 300	7 100	6 300	5 400	6 000	6 200	6 200	5 800

Notes:

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0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Other emissions estimated in the black carbon inventory

Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
Domestic Air Transportation (Cruise)	46	46	44	43	44	48	47	26
International Air Transportation (Cruise)	36	36	36	34	35	38	38	15
International Marine Navigation	0.00	0.00	-	-	0.00	-	-	-

Table A4-10 Black Carbon Emissions Summary for British Columbia (2013 to 2020)

Source Category and Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
ORE AND MINERAL INDUSTRIES	39	35	14	12	27	22	27	34
Aluminium Industry	5.4	3.4	2.1	1.1	1.2	1.1	3.5	3.8
Cement and Concrete Industry	1.8	1.6	1.4	1.4	2.3	2.0	2.1	2.1
Foundries ^a	-	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	31	30	11	9.3	24	19	22	28
OIL AND GAS INDUSTRY	200	220	200	180	190	180	160	170
Disposal and Waste Treatment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Flaring	85	110	92	73	81	78	66	71
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	5.7	5.8	5.0	5.0	5.0	4.9	4.6	4.7
Natural Gas Production and Processing	100	100	94	93	95	93	84	88
Natural Gas Transmission and Storage	7.8	4.8	4.8	5.3	5.3	5.4	5.6	5.6
Natural Gas Distribution	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Oil Sands In-Situ Extraction	-	-	-	-	-	-	-	-
Oil Sands Mining, Extraction and Upgrading	-	-	-	-	-	-	-	-
Petroleum Liquids Storage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Petroleum Liquids Transportation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Well Drilling/Service/Testing	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	10	8.9	8.3	9.1	9.2	10	11	10
Coal	-	-	-	-	-	-	-	-
Diesel	9.6	8.7	8.0	8.5	8.8	9.3	11	9.2
Natural Gas	0.30	0.13	0.12	0.10	0.10	0.14	0.17	0.12
Other (Electric Power Generation)	0.10	0.10	0.22	0.52	0.35	0.73	0.12	0.63
MANUFACTURING	120	96	92	89	83	79	76	84
Pulp and Paper Industry	78	67	64	60	54	52	51	58
Wood Products	40	29	28	28	29	27	25	25
TRANSPORTATION AND MOBILE EQUIPMENT	3 400	3 200	2 600	2 400	2 500	2 900	2 900	2 700
Air Transportation (LTO)	42	41	42	40	43	47	45	27
Domestic Marine Navigation, Fishing and Military	580	690	280	300	280	290	340	340
On-Road Transport	1 100	970	900	920	940	1 000	1 000	990
Diesel	930	850	780	780	800	900	900	870
Gasoline	120	120	120	130	130	140	130	120
Liquid Petroleum Gas	0.30	0.12	0.10	0.10	0.11	0.11	0.10	0.10
Natural Gas	0.15	0.10	0.10	0.10	0.17	0.17	0.16	0.18
Off-Road Transport	1 200	1 000	1 000	810	900	1 100	1 000	940
Diesel	1 100	960	970	750	830	1 000	970	880
Gasoline and Natural Gas	64	68	69	62	63	65	60	61
Rail Transportation	500	440	380	350	370	420	450	420
AGRICULTURE	1.5	1.5	1.6	2.3	2.3	2.5	2.4	2.5
Fuel Use	1.5	1.5	1.6	2.3	2.3	2.5	2.4	2.5
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	570	510	420	470	580	580	620	600
Commercial and Institutional Fuel Combustion	81	79	72	81	85	80	86	88
Construction Fuel Combustion	2.7	2.6	2.8	3.9	3.9	4.2	4.0	4.0
Home Firewood Burning	470	410	330	370	470	480	510	500
Fireplaces	80	65	47	47	51	52	58	53
Furnaces	310	280	230	260	330	310	300	290
Wood Stoves	80	72	59	68	89	120	150	150
Residential Fuel Combustion	17	16	15	16	17	16	17	17
TOTAL	4 300	4 000	3 400	3 200	3 400	3 700	3 800	3 600

Notes:
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 0.00 Indicates emissions were truncated due to rounding.
 - Indicates no emissions

Other emissions estimated in the black carbon inventory

Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
Domestic Air Transportation (Cruise)	40	37	37	39	42	48	47	27
International Air Transportation (Cruise)	96	92	95	95	110	130	120	57
International Marine Navigation	1 300	1 500	650	650	670	720	710	500

Table A4-11 Black Carbon Emissions Summary for Yukon (2013 to 2020)

Source Category and Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
ORE AND MINERAL INDUSTRIES	-	-	-	2.8	2.4	1.7	0.33	0.37
Aluminium Industry	-	-	-	-	-	-	-	-
Cement and Concrete Industry	-	-	-	-	-	-	-	-
Foundries ^a	-	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	-	-	-	2.8	2.4	1.7	0.33	0.37
OIL AND GAS INDUSTRY	-	-	-	-	-	-	-	-
Disposal and Waste Treatment	-	-	-	-	-	-	-	-
Flaring	-	-	-	-	-	-	-	-
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	-	-	-	-	-	-	-	-
Natural Gas Production and Processing	-	-	-	-	-	-	-	-
Natural Gas Transmission and Storage	-	-	-	-	-	-	-	-
Natural Gas Distribution	-	-	-	-	-	-	-	-
Oil Sands In-Situ Extraction	-	-	-	-	-	-	-	-
Oil Sands Mining, Extraction and Upgrading	-	-	-	-	-	-	-	-
Petroleum Liquids Storage	-	-	-	-	-	-	-	-
Petroleum Liquids Transportation	-	-	-	-	-	-	-	-
Well Drilling/Service/Testing	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	-	-	0.69	0.74	1.8	6.8	10	3.1
Coal	-	-	-	-	-	-	-	-
Diesel	-	-	0.69	0.74	1.8	6.8	10	3.1
Natural Gas	-	-	-	-	-	-	-	-
Other (Electric Power Generation)	-	-	-	-	-	-	-	-
MANUFACTURING	-	-	-	-	-	-	-	-
Pulp and Paper Industry	-	-	-	-	-	-	-	-
Wood Products	-	-	-	-	-	-	-	-
TRANSPORTATION AND MOBILE EQUIPMENT	37	18	19	16	17	19	20	22
Air Transportation (LTO)	1.8	1.5	1.4	1.2	1.6	2.0	2.0	0.82
Domestic Marine Navigation, Fishing and Military	0.82	0.85	0.93	0.44	0.14	0.11	0.71	1.3
On-Road Transport	24	7.7	8.1	7.8	9.0	10	10	8.8
Diesel	22	6.3	6.6	6.1	7.3	8.4	8.1	7.0
Gasoline	1.7	1.5	1.5	1.7	1.7	1.9	2.2	1.8
Liquid Petroleum Gas	-	-	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-	-	-
Off-Road Transport	11	8.2	8.8	6.1	5.8	7.1	6.6	11
Diesel	10	7.6	8.2	5.5	5.3	6.4	5.9	9.9
Gasoline and Natural Gas	0.52	0.57	0.59	0.54	0.54	0.68	0.70	0.80
Rail Transportation	-	-	-	-	-	-	-	-
AGRICULTURE	-	-	-	-	-	0.00	-	-
Fuel Use	-	-	-	-	-	0.00	-	-
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	23	16	11	11	9.0	1.5	1.5	1.5
Commercial and Institutional Fuel Combustion	0.30	0.17	0.17	0.15	0.14	0.19	0.20	0.19
Construction Fuel Combustion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Home Firewood Burning	23	15	10	10	8.8	1.3	1.3	1.3
Fireplaces	-	-	-	-	-	-	-	-
Furnaces	23	15	10	10	8.8	1.3	1.3	1.3
Wood Stoves	-	-	-	-	-	-	-	-
Residential Fuel Combustion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	61	34	31	30	30	29	32	26

Notes:

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0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Other emissions estimated in the black carbon inventory

Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
Domestic Air Transportation (Cruise)	1.3	1.1	0.99	0.95	1.0	1.2	1.2	0.62
International Air Transportation (Cruise)	0.17	0.17	0.20	0.18	0.22	0.18	0.16	0.00
International Marine Navigation	0.25	0.20	0.18	0.90	0.31	0.00	0.10	0.13

Table A4-12 Black Carbon Emissions Summary for Northwest Territories (2013 to 2020)

Source Category and Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
ORE AND MINERAL INDUSTRIES	240	240	220	200	220	230	200	150
Aluminium Industry	-	-	-	-	-	-	-	-
Cement and Concrete Industry	-	-	-	-	-	-	-	-
Foundries ^a	-	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	240	240	220	200	220	230	200	150
OIL AND GAS INDUSTRY	3.4	3.2	2.7	2.5	0.15	0.45	2.1	1.5
Disposal and Waste Treatment	-	-	-	-	-	-	-	-
Flaring	0.29	0.29	0.21	0.21	0.00	0.00	0.16	0.12
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	1.1	1.1	0.97	0.89	0.00	0.16	0.73	0.52
Natural Gas Production and Processing	1.3	1.1	0.83	0.79	0.10	0.14	0.69	0.50
Natural Gas Transmission and Storage	-	-	-	-	-	-	-	-
Natural Gas Distribution	-	-	-	-	-	-	-	-
Oil Sands In-Situ Extraction	-	-	-	-	-	-	-	-
Oil Sands Mining, Extraction and Upgrading	-	-	-	-	-	-	-	-
Petroleum Liquids Storage	-	-	-	-	-	-	-	-
Petroleum Liquids Transportation	0.75	0.74	0.67	0.61	0.00	0.11	0.50	0.36
Well Drilling/Service/Testing	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	28	33	42	28	27	28	25	23
Coal	-	-	-	-	-	-	-	-
Diesel	28	33	42	28	27	28	25	23
Natural Gas	0.18	0.12	0.10	0.10	0.10	0.13	0.12	0.10
Other (Electric Power Generation)	-	-	-	-	-	-	-	-
MANUFACTURING	-	-	-	-	-	-	-	-
Pulp and Paper Industry	-	-	-	-	-	-	-	-
Wood Products	-	-	-	-	-	-	-	-
TRANSPORTATION AND MOBILE EQUIPMENT	150	110	110	80	90	80	73	94
Air Transportation (LTO)	9.4	8.1	8.2	7.5	7.4	8.3	7.9	6.1
Domestic Marine Navigation, Fishing and Military	3.5	2.7	2.1	1.6	1.3	1.1	2.1	2.9
On-Road Transport	52	19	18	20	24	26	24	25
Diesel	50	18	17	18	23	25	23	24
Gasoline	1.5	1.3	1.3	1.4	1.5	1.4	1.5	1.2
Liquid Petroleum Gas	-	-	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-	-	-
Off-Road Transport	87	79	78	51	56	44	39	60
Diesel	87	78	77	50	56	44	38	59
Gasoline and Natural Gas	0.64	0.65	0.67	0.60	0.60	0.56	0.56	0.62
Rail Transportation	0.16	0.16	0.14	0.10	0.11	0.10	0.10	0.00
AGRICULTURE	-	-	-	-	-	-	-	-
Fuel Use	-	-	-	-	-	-	-	-
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	16	16	16	24	28	27	27	27
Commercial and Institutional Fuel Combustion	5.2	5.1	5.1	5.6	5.9	5.6	6.1	6.2
Construction Fuel Combustion	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00
Home Firewood Burning	10	10	11	18	22	21	21	21
Fireplaces	-	-	-	-	-	-	-	-
Furnaces	10	10	11	18	22	21	21	21
Wood Stoves	-	-	-	-	-	-	-	-
Residential Fuel Combustion	0.12	0.13	0.11	0.10	0.10	0.10	0.10	0.10
TOTAL	440	400	390	330	360	370	320	300

Notes:

Totals may not add up due to rounding.

Values in this report have been rounded to two significant digits.

a. The Foundries sector is being considered for omission from future inventories. If you have any questions, please contact us at apei-iepa@ec.gc.ca or 1-877-877-8375.

0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Other emissions estimated in the black carbon inventory

Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
Domestic Air Transportation (Cruise)	5.0	4.4	3.9	3.3	3.3	3.8	3.6	2.2
International Air Transportation (Cruise)	0.10	0.10	0.10	0.00	0.10	0.10	0.14	0.00
International Marine Navigation	0.41	0.37	0.43	0.40	0.22	0.00	0.17	0.30

Table A4-13 Black Carbon Emissions Summary for Nunavut (2013 to 2020)

Source Category and Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
ORE AND MINERAL INDUSTRIES	2.9	6.9	17	28	140	16	76	39
Aluminium Industry	-	-	-	-	-	-	-	-
Cement and Concrete Industry	-	-	-	-	-	-	-	-
Foundries ^a	-	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	2.9	6.9	17	28	140	16	76	39
OIL AND GAS INDUSTRY	-	-	-	-	-	-	-	-
Disposal and Waste Treatment	-	-	-	-	-	-	-	-
Flaring	-	-	-	-	-	-	-	-
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	-	-	-	-	-	-	-	-
Natural Gas Production and Processing	-	-	-	-	-	-	-	-
Natural Gas Transmission and Storage	-	-	-	-	-	-	-	-
Natural Gas Distribution	-	-	-	-	-	-	-	-
Oil Sands In-Situ Extraction	-	-	-	-	-	-	-	-
Oil Sands Mining, Extraction and Upgrading	-	-	-	-	-	-	-	-
Petroleum Liquids Storage	-	-	-	-	-	-	-	-
Petroleum Liquids Transportation	-	-	-	-	-	-	-	-
Well Drilling/Service/Testing	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	29	29	29	30	30	31	31	31
Coal	-	-	-	-	-	-	-	-
Diesel	29	29	29	30	30	31	31	31
Natural Gas	-	-	-	-	-	-	-	-
Other (Electric Power Generation)	-	-	-	-	-	-	-	-
MANUFACTURING	-	-	-	-	-	-	-	-
Pulp and Paper Industry	-	-	-	-	-	-	-	-
Wood Products	-	-	-	-	-	-	-	-
TRANSPORTATION AND MOBILE EQUIPMENT	120	78	60	62	53	45	41	38
Air Transportation (LTO)	6.8	5.8	5.6	5.1	5.6	6.4	6.2	4.5
Domestic Marine Navigation, Fishing and Military	27	28	23	26	25	24	22	17
On-Road Transport	26	3.8	2.8	3.7	3.6	2.9	2.7	2.5
Diesel	25	3.2	2.2	2.9	2.8	2.2	2.0	1.8
Gasoline	0.74	0.60	0.57	0.73	0.75	0.66	0.67	0.65
Liquid Petroleum Gas	-	-	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-	-	-
Off-Road Transport	58	40	29	27	19	12	9.9	15
Diesel	57	39	28	26	18	11	9.4	14
Gasoline and Natural Gas	0.90	0.85	0.84	0.78	0.74	0.54	0.49	0.55
Rail Transportation	-	-	-	-	-	-	-	-
AGRICULTURE	-	-	-	-	-	-	-	-
Fuel Use	-	-	-	-	-	-	-	-
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	-	-	-	-	-	-	-	-
Commercial and Institutional Fuel Combustion	-	-	-	-	-	-	-	-
Construction Fuel Combustion	-	-	-	-	-	-	-	-
Home Firewood Burning	-	-	-	-	-	-	-	-
Fireplaces	-	-	-	-	-	-	-	-
Furnaces	-	-	-	-	-	-	-	-
Wood Stoves	-	-	-	-	-	-	-	-
Residential Fuel Combustion	-	-	-	-	-	-	-	-
TOTAL	150	110	110	120	220	92	150	110

Notes:

Totals may not add up due to rounding.

Values in this report have been rounded to two significant digits.

a. The Foundries sector is being considered for omission from future inventories. If you have any questions, please contact us at apei-iepa@ec.gc.ca or 1-877-877-8375.

0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Other emissions estimated in the black carbon inventory

Sector	Black Carbon (tonnes)							
	2013	2014	2015	2016	2017	2018	2019	2020
Domestic Air Transportation (Cruise)	6.2	6.0	5.5	4.6	5.5	6.2	5.7	4.3
International Air Transportation (Cruise)	0.56	0.44	0.42	0.37	0.35	0.54	0.30	0.11
International Marine Navigation	11	13	16	22	18	18	16	8.6

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