

CANADA'S BLACK CARBON INVENTORY REPORT

2013–2019



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50^e anniversaire d'Environnement et Changement climatique Canada

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LIST OF ABBREVIATIONS AND UNITS

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
kg/m ³	kilograms per cubic metre
kt	kilotonne
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
t	tonne
UNECE	United Nations Economic Commission for Europe
U.S. EPA	United States Environmental Protection Agency
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 both near-term warming of the atmosphere and 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.

During Canada's chairpersonship 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 emissions of black carbon by 25-33% of 2013 levels by 2025. Consistent with this commitment, Canada ratified in November 2017 the Gothenburg Protocol and its 2012 amendments under the CLRTAP. The amended Gothenburg Protocol 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, combatting related climate change and human health issues, and to contribute towards the Arctic Council-stated collective aspirational goal.

This report presents the results of the 2021 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

Consistent 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 excluded from Canada's national total emissions.

In 2019, approximately 31 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.

Transportation and Mobile Equipment are by far the largest source of black carbon in Canada, accounting for 19 kt (61%) of total emissions in 2019. Among Transportation and Mobile Equipment, off-road diesel engines account for 9.2 kt (29%) of total emissions. The other large source in this category is diesel engines used for on-road transport, which account for 5.9 kt (19%) of total emissions.

Commercial/Residential/Institutional fuel combustion is the second-largest contributor to black carbon emissions in Canada, accounting for 8.6 kt of black carbon, or 28% of total emissions in 2019. Home Firewood Burning is the largest source in this category, making up 7.4 kt of black carbon, or 24% of total 2019 emissions. Wood is an abundant fuel in Canada. It is estimated that 9.2 million tonnes of firewood were burned in Canadian homes in 2019, an increase of 7% since 2015 (ECCC, 2020).

Since 2013, black carbon emissions in Canada have decreased overall by 5.4 kt (15%), although emissions have increased by 2.8 kt (9.8%) since 2016. Trends in black carbon emissions are largely driven by Transportation and Mobile Equipment and are consistent with observed trends in emissions of PM less than or equal to 2.5 microns in diameter (PM_{2.5}) (upon 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 emissions sources are spatially concentrated. While the black carbon inventory provides valuable information on emissions within 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.

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 2019)

Source Category and Sector	Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019
Ore and Mineral Industries	650	630	570	540	670	580	620
Aluminium Industry	50	46	36	35	35	31	29
Cement and Concrete Industry	14	15	16	18	15	19	16
Foundries	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
Iron Ore Pelletizing	6.3	6.6	7.1	7.3	6.3	5.7	6.5
Mining and Rock Quarrying	470	440	390	360	500	390	430
Oil and Gas Industry	2 200	2 500	2 300	2 100	2 200	2 200	2 300
Disposal and Waste Treatment	0.12	0.13	0.13	0.12	0.12	0.10	0.10
Flaring	970	1 100	1 000	800	860	870	870
Heavy Crude Oil Cold Production	94	96	99	96	97	100	100
Light/Medium Crude Oil Production	160	160	160	150	150	160	160
Natural Gas Production and Processing	530	540	540	530	530	540	530
Natural Gas Transmission and Storage	34	32	32	35	36	36	36
Natural Gas Distribution	0.82	0.74	0.71	0.73	0.75	0.72	0.71
Oil Sands In-Situ Extraction	180	200	210	210	230	250	260
Oil Sands Mining, Extraction and Upgrading	200	310	250	250	290	280	320
Petroleum Liquids Storage	3.4	3.1	3.0	2.7	2.4	4.8	7.7
Petroleum Liquids Transportation	3.9	3.9	3.9	4.1	3.6	3.8	4.2
Well Drilling/Service/Testing	3.0	2.9	1.3	0.89	1.4	1.4	1.1
Electric Power Generation (Utilities)	210	230	240	240	210	220	210
Coal	37	42	40	37	37	36	31
Diesel	130	150	160	160	130	140	140
Natural Gas	12	11	11	9.7	8.5	8.7	7.1
Other (Electric Power Generation)	29	34	34	36	31	31	31
Manufacturing	500	390	410	330	300	280	290
Pulp and Paper Industry	270	220	200	190	170	160	150
Wood Products	230	170	210	140	130	120	140
Transportation and Mobile Equipment	24 000	22 000	20 000	17 000	18 000	19 000	19 000
Air Transportation (LTO)	230	220	210	210	210	230	230
Domestic Marine Navigation, Fishing and Military	1 600	1 700	800	820	850	900	1 000
On-Road Transport	7 600	7 000	6 300	6 200	6 500	6 800	6 700
Diesel	6 800	6 200	5 500	5 300	5 600	5 900	5 900
Gasoline	860	790	780	810	810	820	830
Liquid Petroleum Gas	0.49	0.20	0.15	0.18	0.21	0.21	0.21
Natural Gas	0.21	0.20	0.20	0.30	0.62	0.62	0.57
Off-Road Transport	13 000	11 000	11 000	8 400	9 100	9 800	9 600
Diesel	12 000	11 000	10 000	7 900	8 700	9 300	9 200
Gasoline and Natural Gas	500	510	510	450	460	470	470
Rail Transportation	1 900	1 800	1 500	1 400	1 400	1 500	1 500
Agriculture	56	59	52	51	50	43	20
Fuel Use	56	59	52	51	50	43	20
Commercial/Residential/Institutional	9 000	9 100	8 700	8 200	8 300	8 700	8 600
Commercial and Institutional Fuel Combustion	830	880	840	850	930	960	990
Construction Fuel Combustion	42	41	41	43	44	47	47
Home Firewood Burning	8 000	8 000	7 700	7 200	7 200	7 500	7 400
Fireplaces	900	870	800	730	710	710	680
Furnaces	5 100	5 100	4 900	4 700	4 800	5 100	5 100
Wood Stoves	2 000	2 000	1 900	1 700	1 600	1 700	1 700
Residential Fuel Combustion	160	150	150	140	150	160	160
Total	37 000	35 000	32 000	28 000	30 000	31 000	31 000

Notes:

Totals may not add up due to rounding.

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

0.00 Indicates emissions were truncated due to rounding.

Other emissions estimated in the black carbon inventory

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

Note: Refer to Chapter 2.5 for more information.

1 INTRODUCTION

Black carbon is a short-lived small aerosol (or airborne particle) emitted from combustion processes and linked to both climate warming and adverse health effects.

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 black carbon particles settle on snow and ice, they darken the surface and enhance absorption of solar radiation, thus increasing the rate of melting (Clarke and Noone, 1985). 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 chairpersonship 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 these actions 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 2017 meeting of Arctic Council ministers, Canada, along with other Arctic states, renewed its commitment to take action to reduce black carbon emissions. As part of this commitment, the Arctic Council states also committed to the aspirational goal of reducing collective emissions of black carbon by 25-33% of 2013 levels by 2025. Consistent with this, 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, include new commitments to reduce emissions of particulate matter (PM) and, in doing so, to prioritize sources of PM that are also significant sources of black carbon. Canada's black carbon emissions annual inventory allows Canada to assess its progress in reducing black carbon emissions,

combatting related climate change and human health issues, and to contribute towards the Arctic Council-stated collective aspirational goal. Canada continues to improve the quality and transparency of information related to black carbon emissions.

This document describes the 2021 edition of Canada's annual inventory of anthropogenic black carbon emissions, covering the years from 2013 to 2019. 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 7 source categories that are further broken down into 34 sectors and 9 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 2021 APEI. Please refer to Chapter 3 and Annex 2 of the APEI Report (Environment and Climate Change Canada [ECCC], 2021) for a description of the inventory development and estimation methods for PM_{2.5}. While the black carbon inventory provides valuable information on emissions within 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, 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.

2 BLACK CARBON EMISSIONS AND TRENDS IN CANADA

This chapter describes the main sources and sectors contributing to the black carbon (BC) emissions and their trends since 2013.

Approximately 31 kilotonnes (kt) of black carbon were emitted in Canada in 2019 (Table 2–1). 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

Under each of these source categories, emissions are then grouped under sectors.³ Furthermore, consistent 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 excluded from Canada’s national total emissions.

³ See Annex 1 for descriptions of sectors.

Transportation and Mobile Equipment are by far the most important sources of black carbon in Canada, accounting for 19 kt (61%) of total emissions in 2019 (Table 2–1). Mobile diesel engines alone, which include both on-road and off-road diesel vehicles, accounted for 48% (15 kt) of total emissions.

Commercial/Residential/Institutional sources are the second-largest contributors to black carbon emissions in Canada, making up 8.6 kt or 28% of total emissions. Home Firewood Burning is the largest source in this category, accounting for 7.4 kt of emissions, or 24% of total emissions. Wood is an abundant fuel in Canada; approximately 9.2 million tonnes of firewood were burned in Canadian homes in 2019, an increase of about 7% since 2015 (ECCC, 2020).

Since 2013, black carbon emissions in Canada have decreased overall by 5.4 kt (15%) (Figure 2–1). This overall decrease is attributed to declining emissions from Transportation and Mobile Equipment (4.8 kt or 20%). Emissions from Commercial/Residential/Institutional fuel combustion have decreased from 9.0 kt in 2013 to 8.6 kt in 2019 (0.39 kt or 4.3%). The Oil and Gas Industry sources have shown an overall increase in emissions from 2.2 kt in 2013 to 2.3 kt in 2019 (0.10 kt or 4.7%).

Details on each of the source category as well as their associated sectors can be found in sections 2.1 to 2.7. An overview of the methods 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

Figure 2–1 Trends in Canadian Black Carbon Emissions (2013 to 2019)

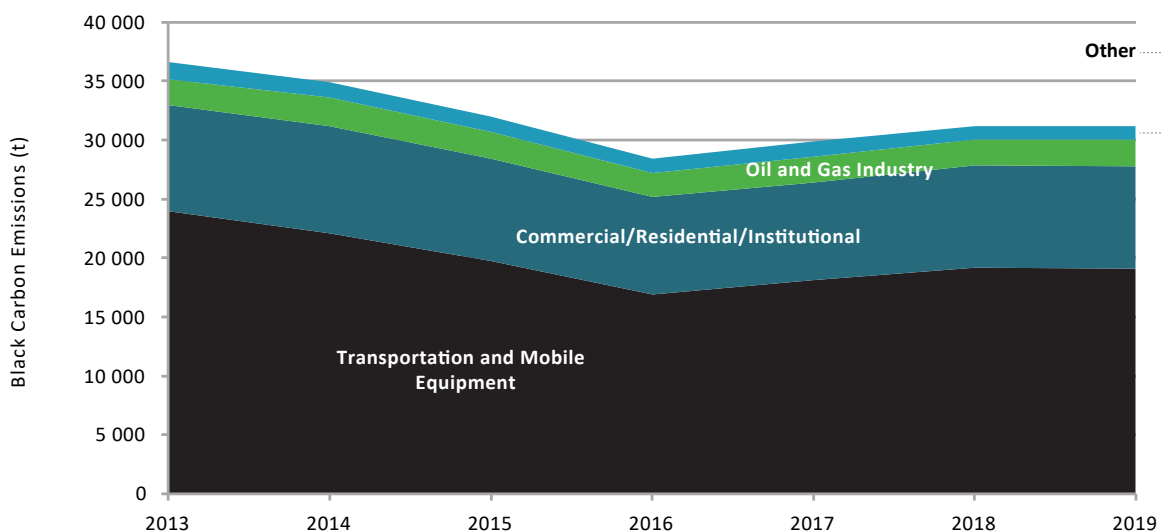


Table 2-1 **Black Carbon Emissions in Canada (2019)**

Source Category and Sector	Black Carbon (tonnes)	Percentage of total
Ore and Mineral Industries	620	2.0%
Aluminium Industry	29	0.1%
Cement and Concrete Industry	16	0.1%
Foundries	0.00	0.0%
Iron and Steel Industry	130	0.4%
Iron Ore Pelletizing	6.5	0.0%
Mining and Rock Quarrying	430	1.4%
Oil and Gas Industry	2 300	7.4%
Disposal and Waste Treatment	0.10	0.0%
Flaring	870	2.8%
Heavy Crude Oil Cold Production	100	0.3%
Light/Medium Crude Oil Production	160	0.5%
Natural Gas Production and Processing	530	1.7%
Natural Gas Transmission and Storage	36	0.1%
Natural Gas Distribution	0.71	0.0%
Oil Sands In-Situ Extraction	260	0.8%
Oil Sands Mining, Extraction and Upgrading	320	1.0%
Petroleum Liquids Storage	7.7	0.0%
Petroleum Liquids Transportation	4.2	0.0%
Well Drilling/Servicing/Testing	1.1	0.0%
Electric Power Generation (Utilities)	210	0.7%
Coal	31	0.1%
Diesel	140	0.5%
Natural Gas	7.1	0.0%
Other (Electric Power Generation)	31	0.1%
Manufacturing	290	0.9%
Pulp and Paper Industry	150	0.5%
Wood Products	140	0.5%
Transportation and Mobile Equipment	19 000	61%
Air Transportation (LTO)	230	0.7%
Domestic Marine Navigation, Fishing and Military	1 000	3.2%
On-Road Transport	6 700	22%
Diesel	5 900	19%
Gasoline	830	2.7%
Liquid Petroleum Gas	0.21	0.0%
Natural Gas	0.57	0.0%
Off-Road Transport	9 600	31%
Diesel	9 200	30%
Gasoline and Natural Gas	470	1.5%
Rail Transportation	1 500	4.8%
Agriculture	20	0.1%
Fuel Use	20	0.1%
Commercial/Residential/Institutional	8 600	28%
Commercial and Institutional Fuel Combustion	990	3.2%
Construction Fuel Combustion	47	0.2%
Home Firewood Burning	7 400	24%
Fireplaces	680	2.2%
Furnaces	5 100	16%
Wood Stoves	1 700	5.5%
Residential Fuel Combustion	160	0.5%
Total	31 000	100%

Notes:

Totals may not add up due to rounding.

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

0.00 Indicates emissions were truncated due to rounding.

Other emissions estimated in the black carbon inventory

Sector	Black Carbon (tonnes)	Percentage of total
Domestic Air Transportation (Cruise)	250	11%
International Air Transportation (Cruise)	490	21%
International Marine Navigation	1 600	68%
Note: Refer to Chapter 2.5 for more information.		

provided in Annex 4. The full-time series of national, provincial, and territorial black carbon emissions from 2013 to 2019 are also available online on the Government of Canada Open Data Portal.⁴

2.1 Ore and Mineral Industries

Ore and Mineral Industry sources 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 Ore and Mineral Industry sources included in this inventory, the Mining and Rock Quarrying sector accounted for the largest proportion (1.4% or 0.43 kt) of total black carbon emissions in 2019 (Figure 2–2). Black carbon emissions from Mining and Rock

Quarrying remained relatively stable since 2013, ranging between 0.40 and 0.56 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 is the Iron and Steel Industry, which accounted for 0.13 kt or 0.4% of total black carbon emissions. Emissions from this sector have increased by 14% since 2013 consistent with a 39% increase in pig iron production and a 13% increase in steel production (Canadian Steel Producers Association [CSPA], 2019).

The Aluminium Industry sector emitted 0.03 kt of black carbon, or 0.1% of the national total, which has decreased by 0.02 kt or 41% since 2013. The decrease can be attributed to the closures of the last three Söderberg aluminium smelters between 2013 and 2015.⁵ Black carbon emissions from the Cement and Concrete Industry increased slightly by 3 t (18%) since 2013 associated with an increase in production.

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

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

Figure 2–2 Trends in Canadian Black Carbon Emissions from Ore and Mineral Industries (2013 to 2019)

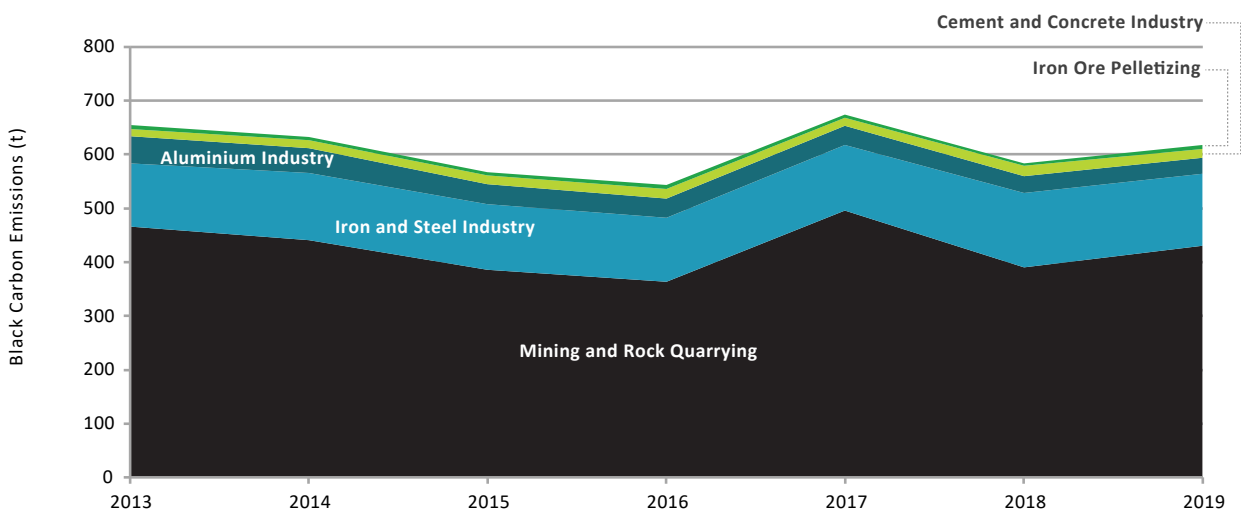


Table 2–2 Emissions of Combustion PM_{2.5} and Black Carbon from Ore and Mineral Industries (2013 to 2019)

Sector	PM _{2.5} from combustion (tonnes)							Black Carbon (tonnes)						
	2019	2013	2015	2016	2017	2017	2019	2013	2014	2015	2016	2017	2018	2019
Aluminium Industry	2 300	2 100	1 700	1 600	1 600	1 400	1 400	50	46	36	35	35	31	29
Cement and Concrete Industry	730	800	860	900	800	930	890	14	15	16	18	15	19	16
Foundries	3.4	3.0	2.9	2.6	1.8	0.10	0.80	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	120	120	120	120	120	140	130
Iron Ore Pelletizing	730	760	820	850	730	660	750	6.3	6.6	7.1	7.3	6.3	5.7	6.5
Mining and Rock Quarrying	2 700	2 300	1 700	1 700	2 300	2 200	2 700	470	440	390	360	500	390	430
Total	8 200	8 100	7 000	6 900	7 600	7 500	8 000	650	630	570	540	670	580	620

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

2.2 Oil and Gas Industry

The Oil and Gas Industry accounted for 2.3 kt or 7.3% of all black carbon emitted in 2019. 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 activities occur in many of the upstream oil and gas sectors, Flaring 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

Of all Oil and Gas sectors included in this inventory, Flaring accounted for the largest proportion (2.8% or 0.87 kt) of total black carbon emissions in 2019 (Figure 2–3). 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 preferential to venting as it reduces emissions of methane and non-methane volatile organic compound. It does, however, increase emissions of carbon monoxide, particulate matter (PM) (and hence black carbon) and nitrogen oxides. From 2018 to 2019 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 0.53 kt or 1.7% of total black carbon emissions, and Oil Sands Mining, Extraction and Upgrading, which accounted for 0.32 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 200 tonnes (51%). This is consistent with a 59% increase in crude bitumen production from mining operations and a 65% 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 2019)

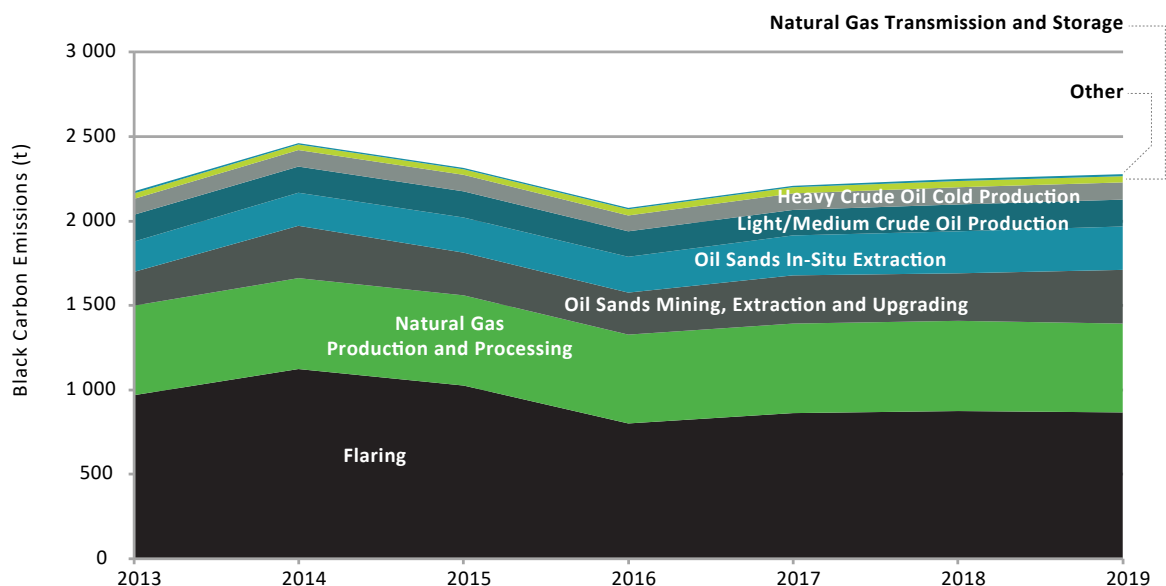
Sector	PM _{2.5} from combustion (tonnes)							Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Disposal and Waste Treatment	0.30	0.34	0.33	0.30	0.30	0.27	0.23	0.12	0.13	0.13	0.12	0.12	0.10	0.10
Flaring	5 000	5 800	5 600	4 600	5 100	5 000	4 900	970	1 100	1 000	800	860	870	870
Heavy Crude Oil Cold Production	160	170	170	160	170	170	170	94	96	99	96	97	100	100
Light/Medium Crude Oil Production	300	300	290	290	290	300	300	160	160	160	150	150	160	160
Natural Gas Production and Processing	1 400	1 400	1 400	1 300	1 300	1 400	1 300	530	540	540	530	530	540	530
Natural Gas Transmission and Storage	88	83	84	92	93	94	95	34	32	32	35	36	36	36
Natural Gas Distribution	2.1	1.9	1.9	1.9	2.0	1.9	1.8	0.82	0.74	0.71	0.73	0.75	0.72	0.71
Oil Sands In-Situ Extraction	460	500	530	540	600	640	660	180	200	210	210	230	250	260
Oil Sands Mining, Extraction and Upgrading	1 300	2 200	1 600	1 700	1 900	1 900	2 100	200	310	250	250	290	280	320
Petroleum Liquids Storage	9.0	8.1	7.9	6.9	6.1	13	20	3.4	3.1	3.0	2.7	2.4	4.8	7.7
Petroleum Liquids Transportation	10	10	10	11	9.3	9.8	11	3.9	3.9	3.9	4.1	3.6	3.8	4.2
Well Drilling/Service/Testing	3.9	3.8	1.7	1.2	1.9	1.9	1.4	3.0	2.9	1.3	0.89	1.4	1.4	1.1
Total	8 700	10 000	9 700	8 700	9 500	9 500	9 600	2 200	2 500	2 300	2 100	2 200	2 200	2 300

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 2019)



Note: "Other" includes 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 0.21 kt (0.7%) of all black carbon emissions in 2019 (Table 2–4 and Figure 2–4). Black carbon emissions from electric power generation are relatively low. This is because large facilities using solid fuels are equipped with particulate controls and boilers and heaters using liquid and gaseous fuels that emit relatively little particulates. 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 was Diesel fuel electric power generation, which accounted for 0.14 kt (0.5%) of total black carbon emissions in 2019. The upward trend in this sector between 2013 and 2019 has largely been influenced by the increased use of diesel-fired electricity generation. This increase has been offset by decreases in the Coal and Natural Gas fuel generation, resulting in an overall decrease for the Electric Power Generation (Utilities) black carbon emission sources for the 2013–2019 time series. The reduction in emissions from coal-fired electricity generation is due to the closure of coal plants in Ontario and reduced consumption of coal in Alberta.

Sector	PM _{2.5} from combustion (tonnes)							Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Coal	2 200	2 500	2 300	2 200	2 200	2 100	1 800	37	42	40	37	37	36	31
Diesel	170	190	210	210	170	180	180	130	150	160	160	130	140	140
Natural Gas	500	420	420	390	340	350	290	12	11	11	9.7	8.5	8.7	7.1
Other (Electric Power Generation)	300	420	420	510	490	420	430	29	34	34	36	31	31	31
Total	3 200	3 500	3 400	3 300	3 200	3 100	2 700	210	230	240	240	210	220	210

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 2019)

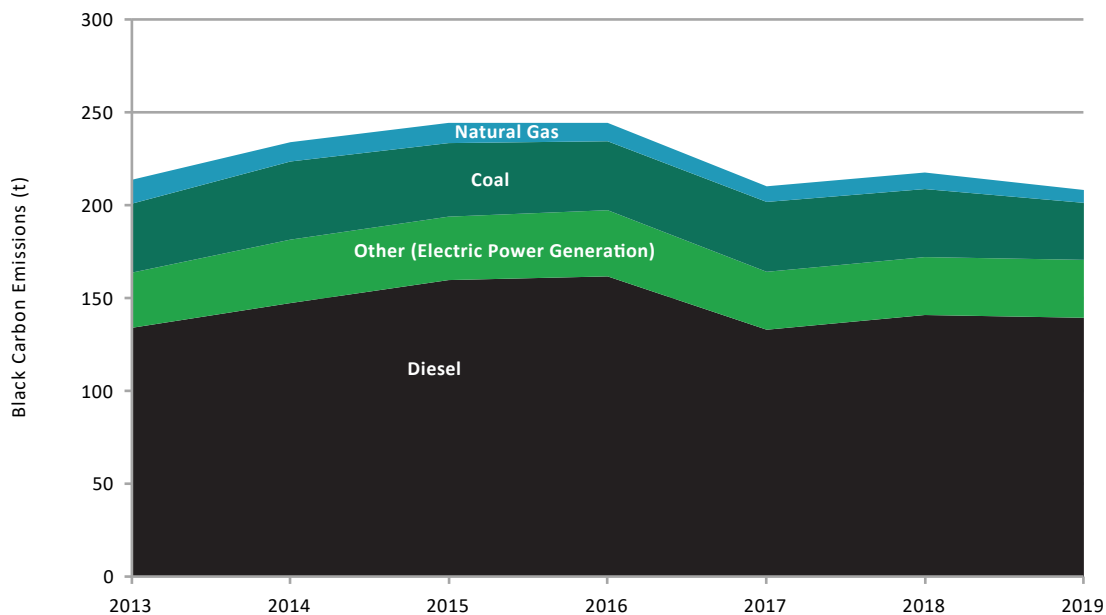


Table 2–5 Emissions of Combustion PM_{2.5} and Black Carbon from Manufacturing (2013 to 2019)

Sector	PM _{2.5} from combustion (tonnes)							Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Pulp and Paper Industry	8 200	7 600	6 900	6 300	5 900	5 400	5 000	270	220	200	190	170	160	150
Wood Products	3 200	2 500	2 800	2 100	1 900	1 900	2 200	230	170	210	140	130	120	140
Total	11 000	10 000	9 700	8 400	7 800	7 300	7 200	500	390	410	330	300	280	290

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

2.4 Manufacturing

Manufacturing sources include the Pulp and Paper Industry and Wood Products sectors (Table 2–5). They accounted for 0.29 kt or 0.9% of total black carbon emissions in 2019. 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 2019 (0.21 kt or 42%) is largely consistent with reduced production in both the Pulp and Paper Industry sector and the Wood Products sector.

2.5 Transportation and Mobile Equipment

Transportation and Mobile Equipment includes 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.

Table 2–6 Emissions of Combustion PM_{2.5} and Black Carbon from Transportation and Mobile Equipment (2013 to 2019)

Sector	PM _{2.5} from combustion (tonnes)							Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Air Transportation (LTO)	300	280	280	270	280	300	290	230	220	210	210	210	230	230
Domestic Marine Navigation, Fishing and Military	3 300	3 100	1 400	1 400	1 500	1 500	1 600	1 600	1 700	800	820	850	900	1 000
On-Road Transport	14 000	13 000	12 000	12 000	12 000	13 000	13 000	7 600	7 000	6 300	6 200	6 500	6 800	6 700
Diesel	11 000	9 700	8 600	8 400	8 900	9 300	9 300	6 800	6 200	5 500	5 300	5 600	5 900	5 900
Gasoline	3 800	3 400	3 300	3 500	3 500	3 500	3 500	860	790	780	810	810	820	830
Liquid Petroleum Gas	2.3	0.83	0.64	0.74	0.88	0.89	0.87	0.49	0.20	0.15	0.18	0.21	0.21	0.21
Natural Gas	1.1	1.0	1.0	1.5	3.0	3.0	2.8	0.21	0.20	0.20	0.30	0.62	0.62	0.57
Off-Road Transport	20 000	18 000	18 000	14 000	15 000	16 000	16 000	13 000	11 000	11 000	8 400	9 100	9 800	9 600
Diesel	16 000	14 000	13 000	10 000	11 000	12 000	12 000	12 000	11 000	10 000	7 900	8 700	9 300	9 200
Gasoline and Natural Gas	4 100	4 200	4 100	3 600	3 700	3 800	3 800	500	510	510	450	460	470	470
Rail Transportation	2 500	2 300	2 000	1 800	1 900	1 900	1 900	1 900	1 800	1 500	1 400	1 400	1 500	1 500
Total	40 000	37 000	34 000	29 000	31 000	33 000	33 000	24 000	22 000	20 000	17 000	18 000	19 000	19 000

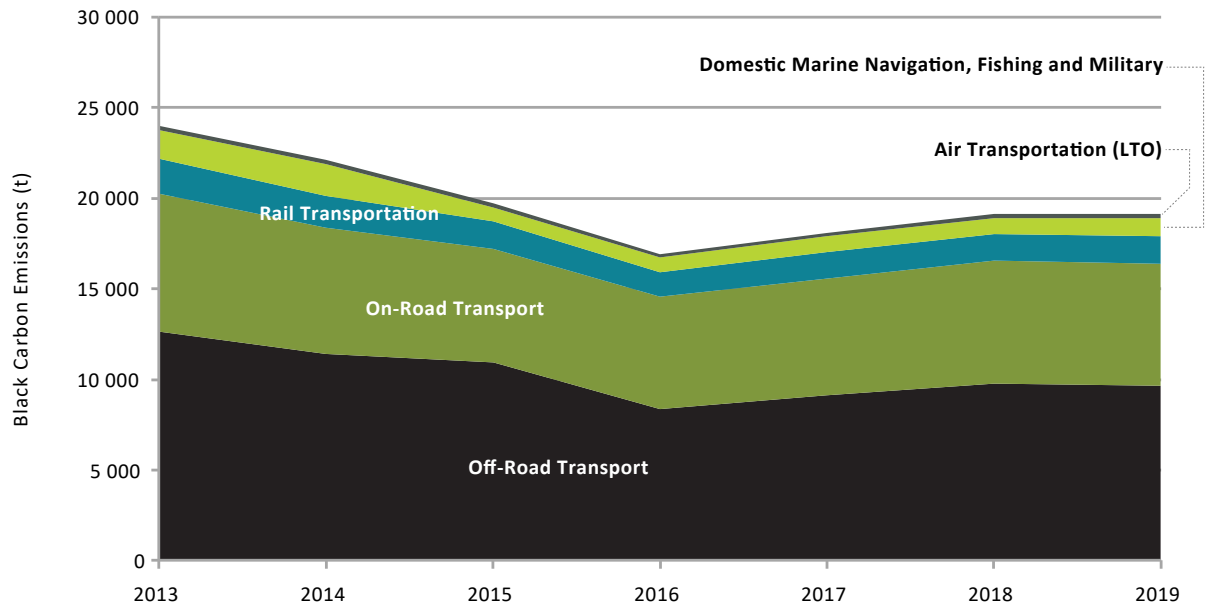
Notes:
Totals may not add up due to rounding.
Values in this report have been rounded to two significant digits.

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	2013	2014	2015	2016	2017	2018	2019
Domestic Air Transportation (Cruise)	290	280	280	280	300	320	330	230	220	210	210	230	250	250
International Air Transportation (Cruise)	480	470	480	500	540	620	640	370	360	370	380	420	480	490
International Marine Navigation	7 100	6 500	2 300	2 300	2 300	2 300	2 300	3 200	3 700	1 600	1 600	1 500	1 500	1 600

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 2019)



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.

Transportation and Mobile Equipment are by far the largest sources of black carbon in Canada, accounting for 19 kt (61%) of total emissions in 2019 (Table 2–1). An important source in this category is mobile diesel engines, both on-road and off-road, which accounted for 48% (15 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 have resulted in decreasing emissions between 2013 and 2019 by 12% (0.9 kt) and 24% (2.9 kt) respectively, contributing to 70% 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 4.0 kt and 13% of the total black carbon emitted in 2019.

The emissions from Domestic Air Transportation (Cruise), International Air Transportation (Cruise) and International Marine Navigation are reported as separate items as those emissions 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 the UNECE refer to Annex 4 of the APEI Report (ECCC, 2021).

Table 2–7 Emissions of Combustion PM_{2.5} and Black Carbon from Agriculture (2013 to 2019)

Sector	PM _{2.5} from combustion (tonnes)							Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Fuel Use	420	440	390	390	380	360	260	56	59	52	51	50	43	20
Total	420	440	390	390	380	360	260	56	59	52	51	50	43	20

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

2.6 Agriculture

Agriculture sources consist of Fuel Use for non-mobile equipment (e.g. for drying grain), and accounted for 0.02 kt (0.1%) of total black carbon emitted in 2019 (Table 2–7). Estimates for these sources are based on the fuel type and quantity consumed in Canada and the corresponding BC/PM_{2.5} fraction. A lower BC/PM_{2.5} fraction specific to agricultural fuel consumption is used.

2.7 Commercial/Residential/Institutional

Commercial/Residential/Institutional sources include Home Firewood Burning and fossil fuel combustion in commercial and institutional buildings, at construction sites and in homes. 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 (7.4 kt or 24%) of total black carbon emissions in 2019 (Table 2–8). Emissions from

Home Firewood Burning are grouped according to 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 2019 (0.6 kt or 7.0%) can be attributed in part to the reduction in the use of conventional fireplaces and wood stoves; that have been replaced with fireplace inserts, furnaces and stoves with improved emission controls and combustion efficiencies.

The next largest source of black carbon emissions in this category is Commercial and Institutional Fuel Combustion, which accounted for 1.0 kt (3.2%) of total black carbon emissions.

Overall, the combustion of fuels, other than wood, accounted for 1.2 kt (3.8%) of total black carbon emissions in 2019 from this category. Estimations 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 (2013 to 2019)

Sector	PM _{2.5} from combustion (tonnes)							Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Commercial and Institutional Fuel Combustion	2 300	2 400	2 300	2 300	2 500	2 600	2 600	830	880	840	850	930	960	990
Construction Fuel Combustion	120	120	120	120	120	130	130	42	41	41	43	44	47	47
Home Firewood Burning	89 000	89 000	85 000	78 000	77 000	80 000	79 000	8 000	8 000	7 700	7 200	7 200	7 500	7 400
Fireplaces	16 000	16 000	14 000	13 000	13 000	13 000	12 000	900	870	800	730	710	710	680
Furnaces	37 000	37 000	36 000	34 000	35 000	37 000	37 000	5 100	5 100	4 900	4 700	4 800	5 100	5 100
Wood Stoves	36 000	36 000	35 000	31 000	29 000	30 000	30 000	2 000	2 000	1 900	1 700	1 600	1 700	1 700
Residential Fuel Combustion	2 400	2 400	2 300	2 200	2 400	2 500	2 400	160	150	150	140	150	160	160
Total	94 000	94 000	90 000	83 000	82 000	85 000	84 000	9 000	9 100	8 700	8 200	8 300	8 700	8 600

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

3 BLACK CARBON INVENTORY DEVELOPMENT

As mentioned in the introduction, the black carbon inventory is based on the Air Pollutant Emissions Inventory (APEI) (Environment and Climate Change Canada [ECCC], 2021). 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 Black Carbon as a Fraction of PM_{2.5}

Two important assumptions underlie the present inventory: black carbon is predominantly emitted in PM_{2.5}, and only PM_{2.5} emissions resulting from combustion contain significant amounts of black carbon. Therefore, 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 important in some cases, PM_{2.5} emissions from non-combustion sources, such as dust raised by traffic on paved and unpaved roads or by wind and machinery on open fields or mine sites, are not considered sources of black carbon.

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, particularly in 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 all 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 Report⁶ (ECCC, 2021).

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).

6 www.canada.ca/apei

Table 3–1 Summary of Methodological Changes, Refinement or Improvements	
Description	Impact on Emissions
Ore and Mineral Industries	
Recalculations occurred in the Aluminium Industry and the Iron and Steel Industry sectors for years 2013 to 2018 as a result of better understanding of processes in these sectors, allowing for more accurate assignment of speciation factors.	The recalculations to the Aluminium Industry sector resulted in increases to the sector-specific emission totals for all years in the time series, ranging from 0.020 tonnes (0.06%) in 2016 to 2.4 tonnes (9%) in 2018. The recalculations in the Iron and Steel Industry sector occurred for all years of the time series, ranging from 27 tonnes (18%) in 2016 to 61 tonnes (30%) in 2018.
Oil and Gas Industry	
In order to reflect the regional variability in gas composition, black carbon emissions from flaring in Alberta are estimated using recently developed natural gas composition data for the upstream oil and gas industry in Alberta by the Energy and Emissions Research Laboratory (EERL) of Carleton University (Tyner and Johnson, 2020). The EERL study uses measured gas composition data from approximately 400 000 wells in Alberta taken over a span of several decades across the province's many oil and gas producing regions to generate gas compositions and higher heating values (HHV) by Alberta township. The township-level HHV data from the EERL study is used in conjunction with flared volumes extracted from the Petrinex (2020) reporting system and the empirical relationship between black carbon and HHV, derived in the Quadram (2019) study, to estimate black carbon emissions for the following upstream oil and gas sectors in Alberta: Natural Gas Production and Processing, Light/Medium Crude Oil Production, Heavy Crude Oil Production and In-situ Oil Sands Production.	These recalculations resulted in minor changes to emissions estimates for the oil and gas sectors, with increases in 2013 and 2014 and decreases from 2015 to 2018. A maximum increase of 1.8 tonnes (0.1%) occurred in 2014, and a maximum decrease of 10.5 tonnes (0.5%) occurred in 2015.
Manufacturing	
Recalculations occurred in the Pulp and Paper Industry sector and Wood Products sector due to the inclusion of missing data from the previous submission.	Changes to Manufacturing are an increase of 36 tonnes (15%) in 2018.
Transportation and Mobile Equipment – Aviation	
Recalculations occurred in the aviation section due to updates to the aviation model. Data sources were updated to include new/current information. Also, aerodromes and aircrafts were further defined to include additional information. Finally, the emissions are now calculated by flight mode (taxi in/out, takeoff, climb-out, climb, cruise, descent and landing). In order to calculate emissions at this level of detail, some emission factors were adjusted to account for each mode.	The recalculations resulted in significant changes for the whole time series. The change will result in an apparent increase of 8.6 tonnes (4%) for 2013, and an apparent increase of 12 tonnes (5%) for 2018.
Transportation and Mobile Equipment – Marine	
Recalculations occurred because updated vessel activity data was incorporated into the marine model. The Marine Emissions Inventory Tool (MEIT) updated their 2015 model and produced data for the 2016, 2017, 2018 calendar years. Provincial estimates were redeveloped based on 2015, 2016, 2017 and 2018 port origin/destination pairs. Emissions associated with international navigation were removed from the report total in order to conform to the national total reported in the NFR tables.	The updated MEIT models resulted in significant changes from 2013 to 2018. The redevelopment port origin/destination pairs had a significant impact on provincial estimates for the whole time series. The change resulted in an apparent decrease of 3373 tonnes (68%) for 2013, and an apparent decrease of 1233 tonnes (44%) for 2018.
Commercial/Residential/Institutional – Home Firewood Burning	
Recalculations occurred in the residential sector from home firewood burning. New firewood consumption data was developed based on data collected from the Statistics Canada Household and Environment Survey (Statistics Canada, 2017). This survey runs every other year, which allows for data coverage throughout the time series.	The recalculations resulted in a decrease of 4 kt from home firewood burning for each year of the time series.

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; ECC, 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.

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 fraction 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.
- 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.
- Include emission estimates for Home Firewood Burning in Canada's North.

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ANNEX 1: SECTOR DESCRIPTIONS

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

Table A1–1 Sector Descriptions	
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	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.
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).

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

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 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	
Fuel Use	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.

ANNEX 2: FRACTIONS OF BLACK CARBON TO PM_{2.5}

The fractions used to convert PM_{2.5} emissions to black carbon emissions are listed in Table A2–1 through Table A2–7.

Table A2–1 Fractions of Black Carbon to PM _{2.5} , Ore and Mineral Industries					
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)
		Aluminium Processing, baghouse (avg)	0.020165	2910110 291012.5 2910130 29101C	Average of 4 speciation factors from U.S. EPA (2014a)
	Primary Aluminium Smelting and Refining	Aluminium Reduction Potline	0.0268	2910210	U.S. EPA (2014a)
		Coal Combustion	0.021321	4373	U.S. EPA (2014a)
		Average of large stack BC/PM _{2.5} fractions	0.02052458	NA	Weighted average (excluding Coal Combustion)
	Secondary Aluminium Production (Includes Recycling)	Secondary Aluminium – Dross Recovery Furnace	0.01426	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)
		Cement Kiln	0.027801	4331	U.S. EPA (2014a)
Foundries	Die Casting	Cast Iron Cupola – Composite	0.0091	91157	U.S. EPA (2014a)
	Ferrous Foundries	Cast Iron Cupola – Composite	0.0091	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)
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 3290	U.S. EPA (2014a)
		Diesel Exhaust	0.77124	3914	U.S. EPA (2014a)
		Average of large stack BC/PM _{2.5} fractions	0.06658	3286 3287 3288 3290	U.S. EPA (2014a)
	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)
	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 900132.5 9001330 90013C	U.S. EPA (2014a)
		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 Fractions of Black Carbon to PM _{2.5} , Oil and Gas Industry				
Sector	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 (2013)
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 (2020a,b); CNLOPB (2020); Petrinex (2020); SKMER (2020)
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)
Oil Sands Mining, Extraction and Upgrading	Biomass Combustion	0.05579138	92105	U.S. EPA (2014a)
Note: NA = Not applicable				

Table A2-3 Fractions of Black Carbon to PM _{2.5} , Electric Power Generation (Utilities)				
Sector	BC/PM _{2.5} fractions		Profile	Reference
	Description	Value (w/w)		
Coal Diesel Natural Gas (Other Electric Power Generation)	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 (2013)
	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)
Notes: 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 Fractions of Black Carbon to PM_{2.5}, Manufacturing

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	0.07447	NA	Weighted average	
	Converted Paper Product Manufacturing	Pulp & Paper Mills – Simplified	0.001	92144	U.S. EPA (2014a)
	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	0.1573	NA	Weighted average
	Wood Products	Sawmills	Wood Products – Drying – Composite	0.08	91128
Wood Products – Sawing – Simplified			0.038	92131	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	0.06547	NA	Weighted average

Note:
NA = Not applicable

Table A2-5 Fractions of Black Carbon to PM_{2.5}, Transportation and Mobile Equipment

Sector	BC/PM _{2.5} fractions		Profile	Reference
	Description	Value (w/w)		
Air Transportation (LTO) Domestic Air Transportation (Cruise) International Air Transportation (Cruise)	Aviation Turbo Fuel (Jet A or B)	0.771241	92106	U.S. EPA (2014a)
	Aviation Gasoline	0.12178	92113	U.S. EPA (2014a)
Domestic Marine Navigation, Fishing and Military International Marine Navigation	Diesel	0.771241	92106	U.S. EPA (2014a)
	Heavy Fuel Oil	0.12	NA	EEA (2019) (Table A2)
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 Fractions of Black Carbon to PM _{2.5} , Agriculture				
Sector	BC/PM _{2.5} fractions		Profile	Reference
	Description	Value (w/w)		
Fuel Use	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 Fractions of Black Carbon to PM _{2.5} , Commercial/Residential/Institutional					
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)
	Conventional Fireplace	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

ANNEX 3: UNECE REPORT ON BLACK CARBON EMISSIONS

Canada is using the UNECE report (template) and the associated Nomenclature for Reporting (NFR) codes for reporting its black carbon emissions internationally (Table A3–1).

NFR Aggregation	NFR Code	Long name	BC emissions (kt)						
			2013	2014	2015	2016	2017	2018	2019
A_PublicPower	1A1a	Public electricity and heat production	0.21	0.23	0.24	0.24	0.21	0.22	0.21
B_Industry	1A1c	Manufacture of solid fuels and other energy industries	1.18	1.31	1.26	1.24	1.32	1.34	1.38
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
B_Industry	1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.05	0.05	0.04	0.04	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	0.19	0.17	0.16	0.15
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
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
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
C_OtherStationaryComb	1A4ai	Commercial/institutional: Stationary	0.83	0.88	0.84	0.85	0.93	0.96	0.99
C_OtherStationaryComb	1A4bi	Residential: Stationary	8.18	8.16	7.82	7.34	7.35	7.65	7.60
C_OtherStationaryComb	1A4ci	Agriculture/forestry/fishing: Stationary	0.07	0.07	0.06	0.06	0.06	0.05	0.04
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
D_Fugitive	1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.97	1.12	1.02	0.80	0.86	0.87	0.87
F_RoadTransport	1A3bi	Road transport: Passenger cars	0.33	0.30	0.29	0.29	0.28	0.28	0.27
F_RoadTransport	1A3bii	Road transport: Light duty vehicles	0.33	0.33	0.33	0.35	0.36	0.38	0.39
F_RoadTransport	1A3biii	Road transport: Heavy duty vehicles and buses	6.98	6.33	5.65	5.51	5.80	6.10	6.08
F_RoadTransport	1A3biv	Road transport: Mopeds and motorcycles	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
H_Aviation	1A3ai(i)	International aviation LTO (civil)	0.02	0.02	0.02	0.02	0.02	0.02	0.02
H_Aviation	1A3aii(i)	Domestic aviation LTO (civil)	0.20	0.18	0.18	0.17	0.18	0.20	0.19
I_Offroad	1A2gvii	Mobile combustion in manufacturing industries and construction: (please specify in the IIR)	5.88	5.22	5.08	3.78	4.19	4.50	4.38
I_Offroad	1A3c	Railways	1.90	1.76	1.51	1.35	1.44	1.47	1.48
I_Offroad	1A3ei	Pipeline transport	0.03	0.03	0.03	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
I_Offroad	1A4aii	Commercial/institutional: Mobile	0.71	0.64	0.66	0.57	0.65	0.68	0.68
I_Offroad	1A4bii	Residential: Household and gardening (mobile)	0.24	0.23	0.23	0.19	0.20	0.21	0.21
I_Offroad	1A4cii	Agriculture/forestry/fishing: Off-road vehicles and other machinery	5.15	4.76	4.41	3.40	3.60	3.90	3.90
I_Offroad	1A4ciii	Agriculture/forestry/fishing: National fishing	0.12	0.08	0.05	0.05	0.04	0.04	0.04
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
J_Waste	5C1bi	Industrial waste incineration	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total			37	35	32	28	30	31	31

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
O_AviCruise	1A3aii(ii)	Domestic aviation cruise (civil)	0.23	0.22	0.21	0.21	0.23	0.25	0.25
O_AviCruise	1A3ai(ii)	International aviation cruise (civil)	0.37	0.36	0.37	0.38	0.42	0.48	0.49
P_IntShipping	1A3di(i)	International maritime navigation	3.16	3.67	1.60	1.57	1.53	1.53	1.64

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.

ANNEX 4: PROVINCIAL AND TERRITORIAL BLACK CARBON EMISSIONS ESTIMATES

Table A4-1 Black Carbon Emissions Summary for Newfoundland (2013 to 2019)							
Sector	Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019
Ore and Mineral Industries	58	45	43	44	24	20	31
Aluminium Industry	-	-	-	-	-	-	-
Cement and Concrete Industry	-	-	-	-	-	-	-
Foundries	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-
Iron Ore Pelletizing	4.0	4.2	4.5	4.6	3.9	3.1	3.6
Mining and Rock Quarrying	54	41	39	39	20	17	27
Oil and Gas Industry	87	100	85	84	97	120	110
Disposal and Waste Treatment	-	-	-	-	-	-	-
Flaring	71	87	73	72	84	110	95
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	16	15	12	12	13	13	14
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
Coal	-	-	-	-	-	-	-
Diesel	24	30	35	50	22	23	19
Natural Gas	-	-	-	-	-	-	-
Other (Electric Power Generation)	0.86	1.3	1.4	1.6	3.0	1.9	2.2
Manufacturing	0.64	0.62	0.81	0.84	1.6	1.6	0.58
Pulp and Paper Industry	0.64	0.62	0.65	0.64	1.4	1.4	0.33
Wood Products	-	-	0.16	0.20	0.20	0.23	0.25
Transportation and Mobile Equipment	550	570	440	420	410	460	490
Air Transportation (LTO)	12	11	11	12	11	11	11
Domestic Marine Navigation, Fishing and Military	260	270	140	140	150	160	180
On-Road Transport	110	120	110	120	100	110	110
Diesel	100	110	100	110	90	98	100
Gasoline	11	11	11	11	11	11	11
Liquid Petroleum Gas	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
Diesel	150	150	170	140	140	170	170
Gasoline and Natural Gas	8.6	10	10	8.9	9.7	9.2	8.9
Rail Transportation	-	-	-	-	-	-	-
Agriculture	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
Commercial/Residential/Institutional	170	160	150	200	250	270	240
Commercial and Institutional Fuel Combustion	2.6	2.9	3.0	2.8	2.5	1.9	1.9
Construction Fuel Combustion	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Home Firewood Burning	170	160	150	190	240	260	230
Fireplaces	10	8.5	7.0	8.1	8.6	7.3	6.7
Furnaces	130	120	110	150	190	200	180
Wood Stoves	33	31	29	38	49	53	47
Residential Fuel Combustion	0.28	0.34	0.29	0.31	0.39	0.38	0.35
Total	890	910	760	800	810	900	880

Notes:
 Totals may not add up due to rounding.
 Values in this report have been rounded to two significant digits.
 0.00 Indicates emissions were truncated due to rounding.
 - Indicates no emissions

Table A4-2 Black Carbon Emissions Summary for Prince Edward Island (2013 to 2019)

Sector	Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019
Ore and Mineral Industries	-	-	-	-	-	-	-
Aluminium Industry	-	-	-	-	-	-	-
Cement and Concrete Industry	-	-	-	-	-	-	-
Foundries	-	-	-	-	-	-	-
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
Coal	-	-	-	-	-	-	-
Diesel	-	-	-	-	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
Manufacturing	-	-	-	-	-	-	-
Pulp and Paper Industry	-	-	-	-	-	-	-
Wood Products	-	-	-	-	-	-	-
Transportation and Mobile Equipment	81	85	84	79	79	84	83
Air Transportation (LTO)	0.54	0.47	0.45	0.48	0.49	0.47	0.48
Domestic Marine Navigation, Fishing and Military	18	20	15	14	15	16	17
On-Road Transport	34	36	37	37	34	36	34
Diesel	30	32	34	33	30	32	31
Gasoline	3.9	3.5	3.3	3.6	3.8	3.5	3.5
Liquid Petroleum Gas	-	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-	-
Off-Road Transport	29	29	32	28	29	32	30
Diesel	27	27	30	26	27	30	28
Gasoline and Natural Gas	2.0	2.0	1.9	2.0	2.3	2.0	2.0
Rail Transportation	-	-	-	-	-	-	-
Agriculture	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
Commercial/Residential/Institutional	88	67	49	75	100	110	100
Commercial and Institutional Fuel Combustion	0.39	0.28	0.27	0.14	0.15	0.17	0.19
Construction Fuel Combustion	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Home Firewood Burning	87	67	49	74	100	110	100
Fireplaces	3.8	2.4	1.3	1.3	0.80	0.75	0.63
Furnaces	73	56	41	64	86	91	89
Wood Stoves	11	8.3	6.2	9.5	13	14	14
Residential Fuel Combustion	0.27	0.22	0.18	0.18	0.19	0.18	0.19
Total	170	150	130	150	180	190	190

Notes:

Totals may not add up due to rounding.

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

0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Table A4-3 Black Carbon Emissions Summary for Nova Scotia (2013 to 2019)

Sector	Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019
Ore and Mineral Industries	1.6	0.26	0.41	0.53	0.92	2.7	1.4
Aluminium Industry	-	-	-	-	-	-	-
Cement and Concrete Industry	0.49	-	0.41	0.53	0.27	2.0	1.4
Foundries	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-
Mining and Rock Quarrying	1.1	0.26	-	-	0.65	0.62	0.00
Oil and Gas Industry	24	27	19	14	9.6	8.9	9.7
Disposal and Waste Treatment	-	-	-	-	-	-	-
Flaring	21	24	17	13	8.5	7.8	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
Coal	4.7	3.8	5.0	2.9	3.2	2.9	3.6
Diesel	-	-	-	-	-	-	-
Natural Gas	0.15	0.24	0.40	0.24	0.14	0.20	0.57
Other (Electric Power Generation)	1.1	1.9	1.1	1.0	1.3	1.9	1.6
Manufacturing	23	23	15	4.3	2.7	4.3	4.3
Pulp and Paper Industry	20	21	12	1.7	0.00	1.8	1.3
Wood Products	3.5	2.8	2.7	2.7	2.7	2.6	3.0
Transportation and Mobile Equipment	550	490	400	350	410	450	430
Air Transportation (LTO)	5.5	5.0	4.9	5.5	5.6	5.9	5.7
Domestic Marine Navigation, Fishing and Military	160	160	81	72	98	110	120
On-Road Transport	170	140	120	120	120	130	120
Diesel	160	130	110	100	110	110	110
Gasoline	14	12	14	14	15	15	15
Liquid Petroleum Gas	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
Diesel	180	150	150	120	140	150	140
Gasoline and Natural Gas	13	12	15	14	16	17	16
Rail Transportation	27	25	25	24	29	31	30
Agriculture	0.10	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
Commercial/Residential/Institutional	690	650	720	630	590	610	580
Commercial and Institutional Fuel Combustion	8.1	7.9	9.3	10	13	12	13
Construction Fuel Combustion	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Home Firewood Burning	680	640	700	620	580	600	570
Fireplaces	52	49	53	47	43	44	41
Furnaces	490	470	520	460	430	450	430
Wood Stoves	130	120	130	120	110	110	100
Residential Fuel Combustion	1.3	1.2	1.2	0.98	1.0	1.1	1.1
Total	1 300	1 200	1 200	1 000	1 000	1 100	1 000

Notes:

Totals may not add up due to rounding.

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

0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Table A4-4 Black Carbon Emissions Summary for New Brunswick (2013 to 2019)

Sector	Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019
Ore and Mineral Industries	1.6	2.3	0.28	0.00	0.00	0.00	0.00
Aluminium Industry	-	-	-	-	-	-	-
Cement and Concrete Industry	0.10	0.10	0.00	0.00	0.00	0.00	0.00
Foundries	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-
Mining and Rock Quarrying	1.5	2.2	0.28	0.00	0.00	0.00	0.00
Oil and Gas Industry	0.10	0.10	0.00	0.10	0.00	0.10	0.00
Disposal and Waste Treatment	-	-	-	-	-	-	-
Flaring	0.10	0.10	0.00	0.10	0.00	0.10	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
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
Coal	0.22	0.11	0.68	0.90	0.28	1.8	0.00
Diesel	-	-	-	-	-	-	-
Natural Gas	2.0	0.87	0.82	0.78	0.34	0.15	0.15
Other (Electric Power Generation)	0.00	0.00	0.10	0.00	0.00	0.00	0.00
Manufacturing	29	28	35	24	23	19	23
Pulp and Paper Industry	8.8	12	11	8.5	7.5	6.2	6.8
Wood Products	21	16	23	16	15	13	16
Transportation and Mobile Equipment	430	400	330	310	290	280	270
Air Transportation (LTO)	4.9	4.3	4.5	4.3	4.3	4.7	4.6
Domestic Marine Navigation, Fishing and Military	62	64	30	32	37	34	43
On-Road Transport	160	140	120	120	110	110	100
Diesel	140	130	110	110	92	93	86
Gasoline	16	13	15	17	15	15	14
Liquid Petroleum Gas	0.00	-	0.00	0.00	0.00	0.00	0.00
Natural Gas	-	-	-	-	-	-	-
Off-Road Transport	150	140	130	110	110	100	95
Diesel	140	130	120	97	94	90	82
Gasoline and Natural Gas	15	14	16	15	14	13	13
Rail Transportation	51	47	36	32	30	30	28
Agriculture	0.37	0.35	0.00	0.00	0.00	0.00	0.00
Fuel Use	0.37	0.35	0.00	0.00	0.00	0.00	0.00
Commercial/Residential/Institutional	930	980	1 000	690	440	450	450
Commercial and Institutional Fuel Combustion	5.6	6.2	6.1	5.7	5.2	5.7	6.1
Construction Fuel Combustion	0.00	0.00	0.10	0.00	0.10	0.00	0.00
Home Firewood Burning	920	980	1 000	680	430	440	450
Fireplaces	85	76	65	32	12	3.8	4.1
Furnaces	630	670	720	490	320	330	330
Wood Stoves	210	220	240	160	100	110	120
Residential Fuel Combustion	0.68	0.79	0.93	0.78	0.59	0.58	0.53
Total	1 400	1 400	1 400	1 000	750	750	750

Notes:

Totals may not add up due to rounding.

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

0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Table A4-5 Black Carbon Emissions Summary for Quebec (2013 to 2019)

Sector	Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019
Ore and Mineral Industries	99	92	78	74	84	97	95
Aluminium Industry	45	43	34	34	33	30	26
Cement and Concrete Industry	1.4	1.6	1.7	0.84	1.5	5.0	2.0
Foundries	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
Iron Ore Pelletizing	2.3	2.3	2.6	2.7	2.4	2.7	2.9
Mining and Rock Quarrying	47	39	35	33	42	49	55
Oil and Gas Industry	2.2	2.1	2.2	2.3	2.4	2.3	2.4
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
Natural Gas Distribution	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
Well Drilling/Service/Testing	-	-	-	-	-	-	-
Electric Power Generation (Utilities)	44	47	49	47	46	47	47
Coal	-	-	-	-	-	-	-
Diesel	22	23	24	24	24	25	24
Natural Gas	0.10	0.10	0.10	0.10	0.00	0.00	0.00
Other (Electric Power Generation)	21	24	24	22	21	22	23
Manufacturing	120	100	95	79	66	63	67
Pulp and Paper Industry	82	64	54	50	50	46	42
Wood Products	36	41	41	30	16	17	26
Transportation and Mobile Equipment	3 800	3 400	3 100	2 800	3 000	3 000	3 000
Air Transportation (LTO)	32	30	29	28	30	33	32
Domestic Marine Navigation, Fishing and Military	380	430	190	200	210	220	260
On-Road Transport	1 400	1 300	1 200	1 200	1 300	1 300	1 300
Diesel	1 300	1 200	1 100	1 100	1 200	1 200	1 200
Gasoline	110	100	100	100	110	110	110
Liquid Petroleum Gas	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
Off-Road Transport	1 700	1 500	1 500	1 200	1 400	1 300	1 300
Diesel	1 600	1 400	1 400	1 100	1 300	1 200	1 200
Gasoline and Natural Gas	92	89	90	77	84	88	88
Rail Transportation	230	180	140	140	120	130	120
Agriculture	1.1	1.1	1.2	1.2	1.1	1.0	1.1
Fuel Use	1.1	1.1	1.2	1.2	1.1	1.0	1.1
Commercial/Residential/Institutional	3 600	3 600	3 600	3 300	3 100	3 200	3 200
Commercial and Institutional Fuel Combustion	110	120	120	130	140	130	130
Construction Fuel Combustion	13	13	12	13	13	15	15
Home Firewood Burning	3 400	3 500	3 400	3 100	2 900	3 000	3 100
Fireplaces	390	400	390	350	330	350	350
Furnaces	1 900	1 900	1 900	1 700	1 600	1 800	1 800
Wood Stoves	1 200	1 200	1 100	1 000	920	940	920
Residential Fuel Combustion	6.3	6.3	6.2	6.3	6.1	6.3	7.2
Total	7 600	7 300	6 900	6 300	6 300	6 400	6 500

Notes:

Totals may not add up due to rounding.

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

0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Table A4-6 Black Carbon Emissions Summary for Ontario (2013 to 2019)

Sector	Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019
Ore and Mineral Industries	170	180	170	150	160	170	160
Aluminium Industry	-	-	-	-	-	-	-
Cement and Concrete Industry	7.6	8.8	9.4	10	9.8	8.6	9.8
Foundries	0.00	-	0.00	0.00	0.00	0.00	0.00
Iron and Steel Industry	110	120	120	120	120	130	120
Iron Ore Pelletizing	-	-	-	-	-	-	-
Mining and Rock Quarrying	52	53	41	28	30	29	28
Oil and Gas Industry	16	15	16	13	14	15	15
Disposal and Waste Treatment	-	-	-	-	-	-	-
Flaring	7.3	6.1	6.3	4.3	4.7	5.6	5.4
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	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
Natural Gas Transmission and Storage	6.0	7.1	7.2	7.2	7.3	7.3	7.3
Natural Gas Distribution	0.15	0.16	0.16	0.17	0.17	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
Petroleum Liquids Transportation	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	19
Coal	2.3	0.10	0.17	0.13	0.23	0.22	0.21
Diesel	13	16	12	12	10	13	14
Natural Gas	6.0	5.5	5.0	4.5	3.5	3.6	3.2
Other (Electric Power Generation)	5.1	5.3	5.9	9.1	3.8	3.5	2.4
Manufacturing	79	75	81	75	76	67	78
Pulp and Paper Industry	35	31	30	29	31	27	27
Wood Products	44	43	52	46	45	41	51
Transportation and Mobile Equipment	5 500	4 800	4 600	3 900	4 100	4 400	4 200
Air Transportation (LTO)	57	50	51	52	53	58	55
Domestic Marine Navigation, Fishing and Military	69	70	37	35	37	38	32
On-Road Transport	2 000	1 700	1 500	1 500	1 500	1 600	1 600
Diesel	1 700	1 500	1 300	1 200	1 300	1 400	1 300
Gasoline	240	230	220	230	220	230	240
Liquid Petroleum Gas	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
Off-Road Transport	3 000	2 600	2 700	2 000	2 200	2 400	2 300
Diesel	2 900	2 400	2 500	1 900	2 000	2 200	2 100
Gasoline and Natural Gas	190	190	190	160	170	170	170
Rail Transportation	340	330	300	300	280	300	300
Agriculture	8.8	6.9	5.4	5.4	4.8	5.0	5.4
Fuel Use	8.8	6.9	5.4	5.4	4.8	5.0	5.4
Commercial/Residential/Institutional	2 200	2 300	2 100	2 000	2 100	2 200	2 200
Commercial and Institutional Fuel Combustion	360	400	380	360	370	390	410
Construction Fuel Combustion	10	9.8	9.4	9.7	8.8	9.0	9.6
Home Firewood Burning	1 800	1 800	1 600	1 500	1 600	1 700	1 700
Fireplaces	260	250	220	210	210	220	200
Furnaces	1 200	1 200	1 100	1 000	1 100	1 100	1 100
Wood Stoves	360	360	320	310	310	330	360
Residential Fuel Combustion	77	77	78	73	77	82	81
Total	8 000	7 400	6 900	6 100	6 400	6 800	6 700

Notes:

Totals may not add up due to rounding.

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

0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Table A4-7 Black Carbon Emissions Summary for Manitoba (2013 to 2019)

Sector	Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019
Ore and Mineral Industries	0.24	0.23	0.25	0.23	0.72	0.69	0.67
Aluminium Industry	-	-	-	-	-	-	-
Cement and Concrete Industry	0.20	0.18	0.21	0.19	0.39	0.38	0.36
Foundries	-	-	-	-	-	-	-
Iron and Steel Industry	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
Oil and Gas Industry	32	31	29	27	25	29	31
Disposal and Waste Treatment	-	-	-	-	-	-	-
Flaring	31	30	28	26	24	26	27
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	0.39	0.38	0.35	0.33	0.30	0.33	0.34
Natural Gas Production and Processing	-	-	-	-	-	-	-
Natural Gas Transmission and Storage	0.13	0.26	0.42	0.26	0.16	0.41	0.44
Natural Gas Distribution	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
Petroleum Liquids Transportation	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
Coal	-	-	-	-	-	-	-
Diesel	2.5	2.6	2.8	2.7	2.7	2.7	2.6
Natural Gas	0.17	0.15	0.23	0.10	0.10	0.00	0.00
Other (Electric Power Generation)	-	-	-	-	-	-	-
Manufacturing	14	12	10	15	14	15	14
Pulp and Paper Industry	14	11	10	15	14	14	11
Wood Products	0.72	0.64	0.39	0.60	0.68	0.88	2.2
Transportation and Mobile Equipment	1 100	1 100	950	900	980	1 000	990
Air Transportation (LTO)	17	15	15	15	16	17	17
Domestic Marine Navigation, Fishing and Military	1.1	0.62	0.24	0.00	0.29	0.83	0.53
On-Road Transport	300	310	260	290	320	330	320
Diesel	250	260	210	240	270	280	270
Gasoline	55	50	46	47	46	49	48
Liquid Petroleum Gas	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
Diesel	610	590	510	440	470	480	460
Gasoline and Natural Gas	20	22	21	18	18	21	20
Rail Transportation	150	150	150	140	150	170	170
Agriculture	0.11	0.10	0.10	0.10	0.10	0.12	0.12
Fuel Use	0.11	0.10	0.10	0.10	0.10	0.12	0.12
Commercial/Residential/Institutional	270	270	240	250	280	310	300
Commercial and Institutional Fuel Combustion	43	46	41	40	43	47	47
Construction Fuel Combustion	5.2	4.7	4.5	5.0	4.3	4.8	4.8
Home Firewood Burning	220	220	190	200	230	250	250
Fireplaces	7.0	6.8	5.8	6.1	6.9	7.5	7.1
Furnaces	200	200	180	190	220	240	230
Wood Stoves	8.4	7.7	6.1	6.0	6.1	5.9	5.0
Residential Fuel Combustion	5.0	5.0	4.2	4.2	4.6	4.9	4.9
Total	1 400	1 400	1 200	1 200	1 300	1 400	1 300

Notes:

Totals may not add up due to rounding.

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

0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Table A4-8 Black Carbon Emissions Summary for Saskatchewan (2013 to 2019)

Sector	Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019
Ore and Mineral Industries	33	29	25	23	19	22	27
Aluminium Industry	-	-	-	-	-	-	-
Cement and Concrete Industry	-	-	-	0.00	-	-	-
Foundries	-	-	-	-	-	-	-
Iron and Steel Industry	0.10	0.20	0.11	0.10	0.17	0.14	0.12
Iron Ore Pelletizing	-	-	-	-	-	-	-
Mining and Rock Quarrying	32	28	25	23	19	22	27
Oil and Gas Industry	340	380	370	310	300	290	270
Disposal and Waste Treatment	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Flaring	290	340	330	270	260	250	230
Heavy Crude Oil Cold Production	10	11	11	9.2	9.2	9.0	8.6
Light/Medium Crude Oil Production	5.7	3.4	3.7	3.8	3.5	3.8	3.2
Natural Gas Production and Processing	15	15	15	15	15	15	15
Natural Gas Transmission and Storage	7.2	6.3	6.3	6.3	6.3	6.3	6.3
Natural Gas Distribution	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Oil Sands In-Situ Extraction	1.5	1.1	0.99	1.1	0.68	1.6	1.6
Oil Sands Mining, Extraction and Upgrading	4.6	2.3	3.6	2.3	2.1	1.9	3.2
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	10
Coal	3.7	3.7	3.8	3.7	3.6	11	8.7
Diesel	-	-	0.45	0.36	0.39	0.39	0.38
Natural Gas	1.6	1.5	1.8	1.8	2.1	2.1	0.94
Other (Electric Power Generation)	-	-	-	-	-	0.00	0.00
Manufacturing	28	3.4	4.3	4.4	4.4	4.7	4.5
Pulp and Paper Industry	0.32	0.29	0.13	0.00	0.00	0.17	0.00
Wood Products	27	3.1	4.2	4.3	4.4	4.5	4.5
Transportation and Mobile Equipment	2 900	2 900	2 700	2 300	2 500	2 700	2 600
Air Transportation (LTO)	13	12	11	10	9.8	10	9.5
Domestic Marine Navigation, Fishing and Military	-	-	-	-	-	-	-
On-Road Transport	620	630	580	570	610	640	620
Diesel	500	540	480	470	510	540	520
Gasoline	120	95	97	100	99	96	95
Liquid Petroleum Gas	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
Off-Road Transport	2 100	2 100	1 900	1 500	1 700	1 800	1 800
Diesel	2 100	2 000	1 900	1 500	1 600	1 800	1 700
Gasoline and Natural Gas	30	29	30	25	25	23	23
Rail Transportation	180	170	170	160	220	240	260
Agriculture	10	13	11	10	11	10	9.6
Fuel Use	10	13	11	10	11	10	9.6
Commercial/Residential/Institutional	140	130	120	140	170	180	190
Commercial and Institutional Fuel Combustion	36	37	36	43	48	52	54
Construction Fuel Combustion	1.3	1.5	1.8	1.3	1.7	1.7	1.3
Home Firewood Burning	89	85	71	84	110	120	120
Fireplaces	4.8	5.3	5.0	6.5	9.2	11	12
Furnaces	80	76	63	74	94	110	110
Wood Stoves	4.2	3.9	3.1	3.5	4.3	4.6	4.3
Residential Fuel Combustion	10	9.8	8.4	7.9	7.8	8.5	9.0
Total	3 500	3 400	3 200	2 800	3 000	3 200	3 100

Notes:

Totals may not add up due to rounding.

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

0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Table A4-9 Black Carbon Emissions Summary for Alberta (2013 to 2019)

Sector	Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019
Ore and Mineral Industries	4.3	4.2	3.6	5.0	3.1	3.0	3.4
Aluminium Industry	-	-	-	-	-	-	-
Cement and Concrete Industry	2.2	2.3	3.2	4.8	1.2	0.84	0.72
Foundries	-	-	-	-	-	-	-
Iron and Steel Industry	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	1.8	2.2	2.7
Oil and Gas Industry	1 500	1 700	1 600	1 500	1 600	1 600	1 700
Disposal and Waste Treatment	0.10	0.11	0.11	0.10	0.10	0.10	0.10
Flaring	460	520	480	340	400	400	440
Heavy Crude Oil Cold Production	84	86	88	86	88	92	91
Light/Medium Crude Oil Production	130	130	130	130	130	140	140
Natural Gas Production and Processing	410	420	420	410	420	420	420
Natural Gas Transmission and Storage	12	13	13	16	16	16	17
Natural Gas Distribution	0.46	0.37	0.32	0.32	0.34	0.33	0.31
Oil Sands In-Situ Extraction	180	190	210	210	230	250	250
Oil Sands Mining, Extraction and Upgrading	200	310	250	250	290	280	320
Petroleum Liquids Storage	2.9	2.5	2.6	2.2	0.99	1.0	3.9
Petroleum Liquids Transportation	1.1	1.2	1.3	1.4	1.4	1.5	1.5
Well Drilling/Service/Testing	3.0	2.9	1.3	0.89	1.4	1.4	1.1
Electric Power Generation (Utilities)	35	42	38	38	39	27	24
Coal	26	34	30	29	30	21	18
Diesel	4.8	4.9	5.1	5.2	6.0	2.3	2.7
Natural Gas	2.0	2.0	2.0	2.0	2.2	2.3	1.9
Other (Electric Power Generation)	1.4	1.3	1.3	1.2	1.2	1.2	1.3
Manufacturing	84	50	76	35	24	25	24
Pulp and Paper Industry	32	16	18	22	11	12	9.9
Wood Products	53	34	58	13	14	13	14
Transportation and Mobile Equipment	5 700	5 300	4 500	3 500	3 800	4 000	4 200
Air Transportation (LTO)	33	31	29	26	27	30	29
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	1 500
Diesel	1 500	1 500	1 200	1 100	1 200	1 300	1 300
Gasoline	160	160	140	150	150	160	160
Liquid Petroleum Gas	0.12	0.00	0.00	0.00	0.10	0.10	0.10
Natural Gas	0.00	0.00	0.00	0.11	0.36	0.36	0.32
Off-Road Transport	3 200	2 900	2 600	1 800	2 000	2 200	2 300
Diesel	3 200	2 900	2 500	1 800	1 900	2 100	2 200
Gasoline and Natural Gas	62	69	65	60	61	63	63
Rail Transportation	780	690	540	390	400	360	370
Agriculture	34	35	33	32	31	25	1.2
Fuel Use	34	35	33	32	31	25	1.2
Commercial/Residential/Institutional	380	370	320	510	770	820	830
Commercial and Institutional Fuel Combustion	180	190	170	190	230	250	250
Construction Fuel Combustion	9.7	9.8	10	11	12	13	13
Home Firewood Burning	160	140	110	280	490	520	530
Fireplaces	12	9.7	7.0	17	28	27	25
Furnaces	130	120	91	240	420	450	460
Wood Stoves	10	9.4	7.4	20	37	41	43
Residential Fuel Combustion	40	38	35	34	37	39	37
Total	7 700	7 500	6 600	5 600	6 200	6 500	6 700

Notes:

Totals may not add up due to rounding.

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

0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Table A4-10 Black Carbon Emissions Summary for British Columbia (2013 to 2019)

Sector	Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019
Ore and Mineral Industries	38	34	14	12	27	23	23
Aluminium Industry	4.9	3.1	1.9	0.98	1.1	1.0	3.2
Cement and Concrete Industry	1.8	1.7	1.4	1.4	2.3	2.0	2.1
Foundries	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-
Mining and Rock Quarrying	31	30	11	9.3	24	20	18
Oil and Gas Industry	200	220	200	180	190	180	150
Disposal and Waste Treatment	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Flaring	85	110	92	73	81	78	62
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	5.7	5.8	5.0	5.0	5.0	5.0	4.4
Natural Gas Production and Processing	100	100	94	93	95	95	83
Natural Gas Transmission and Storage	7.8	4.8	4.8	5.3	5.3	5.4	5.5
Natural Gas Distribution	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
Petroleum Liquids Transportation	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	12
Coal	-	-	-	-	-	-	-
Diesel	9.6	8.7	8.0	8.5	8.8	9.3	11
Natural Gas	0.30	0.13	0.12	0.10	0.10	0.14	0.17
Other (Electric Power Generation)	0.10	0.10	0.22	0.52	0.35	0.73	0.72
Manufacturing	120	96	92	89	83	79	75
Pulp and Paper Industry	78	67	64	60	54	52	51
Wood Products	40	29	28	28	29	27	24
Transportation and Mobile Equipment	3 000	2 900	2 400	2 200	2 400	2 600	2 600
Air Transportation (LTO)	42	41	42	40	43	47	45
Domestic Marine Navigation, Fishing and Military	580	690	280	300	280	290	340
On-Road Transport	1 100	970	900	920	940	1 000	1 000
Diesel	930	850	780	780	800	900	900
Gasoline	120	120	120	130	130	140	130
Liquid Petroleum Gas	0.30	0.12	0.10	0.10	0.11	0.11	0.10
Natural Gas	0.15	0.10	0.10	0.10	0.17	0.17	0.16
Off-Road Transport	1 200	1 000	1 000	810	900	1 100	1 000
Diesel	1 100	960	970	750	830	1 000	970
Gasoline and Natural Gas	64	68	69	62	63	65	60
Rail Transportation	140	160	140	170	210	200	190
Agriculture	1.5	1.5	1.6	2.3	2.3	2.5	2.4
Fuel Use	1.5	1.5	1.6	2.3	2.3	2.5	2.4
Commercial/Residential/Institutional	570	510	420	460	580	530	530
Commercial and Institutional Fuel Combustion	81	79	72	73	84	80	86
Construction Fuel Combustion	2.7	2.6	2.8	3.9	3.9	4.2	4.0
Home Firewood Burning	470	410	330	370	470	430	420
Fireplaces	80	65	47	47	51	38	28
Furnaces	310	280	230	260	330	310	310
Wood Stoves	80	72	59	68	89	84	84
Residential Fuel Combustion	17	16	15	15	17	16	17
Total	3 900	3 800	3 100	3 000	3 300	3 500	3 400

Notes:

Totals may not add up due to rounding.

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

0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Table A4-11 Black Carbon Emissions Summary for Yukon (2013 to 2019)

Sector	Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019
Ore and Mineral Industries	-	-	-	2.8	2.4	1.7	0.33
Aluminium Industry	-	-	-	-	-	-	-
Cement and Concrete Industry	-	-	-	-	-	-	-
Foundries	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-
Mining and Rock Quarrying	-	-	-	2.8	2.4	1.7	0.33
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
Coal	-	-	-	-	-	-	-
Diesel	-	-	0.69	0.74	1.8	6.8	10
Natural Gas	-	-	-	-	-	-	-
Other (Electric Power Generation)	-	-	-	-	-	-	-
Manufacturing	-	-	-	-	-	-	-
Pulp and Paper Industry	-	-	-	-	-	-	-
Wood Products	-	-	-	-	-	-	-
Transportation and Mobile Equipment	37	18	19	16	17	19	20
Air Transportation (LTO)	1.8	1.5	1.4	1.2	1.6	2.0	2.0
Domestic Marine Navigation, Fishing and Military	0.82	0.85	0.93	0.44	0.14	0.11	0.71
On-Road Transport	24	7.7	8.1	7.8	9.0	10	10
Diesel	22	6.3	6.6	6.1	7.3	8.4	8.1
Gasoline	1.7	1.5	1.5	1.7	1.7	1.9	2.2
Liquid Petroleum Gas	-	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-	-
Off-Road Transport	11	8.2	8.8	6.1	5.8	7.1	6.6
Diesel	10	7.6	8.2	5.5	5.3	6.4	5.9
Gasoline and Natural Gas	0.52	0.57	0.59	0.54	0.54	0.68	0.70
Rail Transportation	-	-	-	-	-	-	-
Agriculture	-	-	-	-	-	0.00	-
Fuel Use	-	-	-	-	-	0.00	-
Commercial/Residential/Institutional	0.34	0.19	0.19	0.16	0.16	0.21	0.23
Commercial and Institutional Fuel Combustion	0.30	0.17	0.17	0.15	0.14	0.19	0.20
Construction Fuel Combustion	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Home Firewood Burning	-	-	-	-	-	-	-
Fireplaces	-	-	-	-	-	-	-
Furnaces	-	-	-	-	-	-	-
Wood Stoves	-	-	-	-	-	-	-
Residential Fuel Combustion	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	38	18	20	19	21	28	30

Notes:

Totals may not add up due to rounding.

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

0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Table A4-12 Black Carbon Emissions Summary for Northwest Territories (2013 to 2019)

Sector	Black Carbon (tonnes)						
	2013	2014	2015	2016	2017	2018	2019
Ore and Mineral Industries	240	240	220	200	220	230	200
Aluminium Industry	-	-	-	-	-	-	-
Cement and Concrete Industry	-	-	-	-	-	-	-
Foundries	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-
Mining and Rock Quarrying	240	240	220	200	220	230	200
Oil and Gas Industry	3.4	3.2	2.7	2.5	0.15	0.45	2.1
Disposal and Waste Treatment	-	-	-	-	-	-	-
Flaring	0.29	0.29	0.21	0.21	0.00	0.00	0.16
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	1.1	1.1	0.97	0.89	0.00	0.16	0.73
Natural Gas Production and Processing	1.3	1.1	0.83	0.79	0.10	0.14	0.69
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
Well Drilling/Service/Testing	-	-	-	-	-	-	-
Electric Power Generation (Utilities)	28	33	42	28	27	28	25
Coal	-	-	-	-	-	-	-
Diesel	28	33	42	28	27	28	25
Natural Gas	0.18	0.12	0.10	0.10	0.10	0.13	0.12
Other (Electric Power Generation)	-	-	-	-	-	-	-
Manufacturing	-	-	-	-	-	-	-
Pulp and Paper Industry	-	-	-	-	-	-	-
Wood Products	-	-	-	-	-	-	-
Transportation and Mobile Equipment	110	110	130	96	80	72	71
Air Transportation (LTO)	9.4	8.1	8.2	7.5	7.4	8.3	7.9
Domestic Marine Navigation, Fishing and Military	3.5	2.7	2.1	1.6	1.3	1.1	2.1
On-Road Transport	36	19	23	23	21	22	23
Diesel	34	17	21	22	19	21	21
Gasoline	1.1	1.3	1.3	1.4	1.4	1.5	1.5
Liquid Petroleum Gas	-	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-	-
Off-Road Transport	60	76	97	61	48	38	36
Diesel	60	76	97	60	48	37	35
Gasoline and Natural Gas	0.45	0.65	0.67	0.60	0.57	0.61	0.56
Rail Transportation	2.8	4.2	3.3	2.7	2.5	2.5	2.5
Agriculture	-	-	-	-	-	-	-
Fuel Use	-	-	-	-	-	-	-
Commercial/Residential/Institutional	16	16	16	24	23	24	22
Commercial and Institutional Fuel Combustion	5.2	5.1	5.1	5.6	0.74	2.5	0.53
Construction Fuel Combustion	0.00	0.00	0.00	0.00	0.00	0.00	-
Home Firewood Burning	10	10	11	18	22	21	21
Fireplaces	-	-	-	-	-	-	-
Furnaces	10	10	11	18	22	21	21
Wood Stoves	-	-	-	-	-	-	-
Residential Fuel Combustion	0.12	0.13	0.11	0.10	0.10	0.10	0.10
Total	400	400	410	350	350	360	320

Notes:

Totals may not add up due to rounding.

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

0.00 Indicates emissions were truncated due to rounding.

- Indicates no emissions

Table A4-13 **Black Carbon Emissions Summary for Nunavut (2013 to 2019)**

Black Carbon (tonnes)							
Sector	2013	2014	2015	2016	2017	2018	2019
Ore and Mineral Industries	2.9	6.9	17	28	140	16	76
Aluminium Industry	-	-	-	-	-	-	-
Cement and Concrete Industry	-	-	-	-	-	-	-
Foundries	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-
Mining and Rock Quarrying	2.9	6.9	17	28	140	16	76
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
Coal	-	-	-	-	-	-	-
Diesel	29	29	29	30	30	31	31
Natural Gas	-	-	-	-	-	-	-
Other (Electric Power Generation)	-	-	-	-	-	-	-
Manufacturing	-	-	-	-	-	-	-
Pulp and Paper Industry	-	-	-	-	-	-	-
Wood Products	-	-	-	-	-	-	-
Transportation and Mobile Equipment	120	78	59	62	53	45	41
Air Transportation (LTO)	6.8	5.8	5.6	5.1	5.6	6.4	6.2
Domestic Marine Navigation, Fishing and Military	27	28	23	26	25	24	22
On-Road Transport	26	3.8	2.7	3.7	3.6	2.9	2.7
Diesel	25	3.2	2.1	2.9	2.8	2.2	2.0
Gasoline	0.74	0.60	0.57	0.73	0.75	0.66	0.67
Liquid Petroleum Gas	-	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-	-
Off-Road Transport	58	40	28	27	19	12	9.9
Diesel	57	39	27	26	18	11	9.4
Gasoline and Natural Gas	0.90	0.85	0.84	0.78	0.74	0.54	0.49
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	100	120	220	92	150

Notes:

Totals may not add up due to rounding.

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

- Indicates no emissions

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