CANADA'S **BLACK CARBON INVENTORY** REPORT

2013–2021

2023

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LIST OF ABBREVIATIONS AND UNITS

Abbreviations

APEI	Air Pollutant Emissions Inventory
BC	black carbon
CLRTAP	Convention on Long-Range Transboundary Air Pollution
ECCC	Environment and Climate Change Canada
EEA	European Environment Agency
EMEP	European Monitoring and Evaluation Programme
EPG	electrical power generation
IE	included elsewhere
LTO	landing and takeoff
MOVES	Motor Vehicle Emission Simulator
NFR	Nomenclature for Reporting
NPRI	National Pollutant Release Inventory
PM	particulate matter
$PM_{2.5}$	particulate matter less than or equal to 2.5 microns in diameter
QA	quality assurance
QC	quality control
UNECE	United Nations Economic Commission for Europe
U.S. EPA	United States Environmental Protection Agency
VKT	Vehicle kilometres traveled

Units

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

EXECUTIVE SUMMARY

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

During Canada's term as Chair of the Arctic Council, from 2013 to 2015, the Council first promoted actions to achieve enhanced reductions of black carbon and methane emissions. The Framework for Action on Enhanced Black Carbon and Methane Emissions Reductions was agreed upon in April 2015. It includes a commitment from all Arctic states to develop and improve emission inventories for black carbon using, where possible, relevant guidelines from the Convention on Long-Range Transboundary Air Pollution (CLRTAP). In 2017, the eight Arctic Council states also committed to the aspirational goal of reducing collective black carbon emissions by 25% to 33% relative to 2013 levels by 2025. In November 2017, Canada ratified the Gothenburg Protocol and its 2012 amendments, which include black carbon as a component of fine particulate matter. The amended Gothenburg Protocol under CLRTAP is the first legally binding instrument to include a focus on black carbon. Canada's black carbon emissions inventory allows Canada to assess its progress in reducing black carbon emissions and combatting related climate change and human health issues, and to contribute towards the Arctic Council's collective aspirational goal.

This report presents the results of the 2023 edition of Canada's annual inventory of black carbon emissions. Emissions in this inventory are grouped according to the following source categories:[1]

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

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

In 2021, approximately 26 kilotonnes (kt) of black carbon were emitted in Canada (Table ES–1).[2] All emissions reported in this inventory are from anthropogenic (human) sources. Natural sources of black carbon, such as wildfires, are not included.

The most recent years for which data are available for this report, the years 2020 and 2021, were marked by the COVID-19 pandemic, coinciding with observed decreases in emissions of 3.4 kt or 11% between 2019 and 2020, and 0.43 kt or 1.7% between the years 2020 and 2021. This is most notable in Transportation and Mobile Equipment where emissions decreased 2.6 kt or 15% between 2019 and 2020 and 0.31 kt or 2.1% between 2020 and 2021, mostly from off-road diesel equipment. There were less off-road diesel engines in use in 2020 relative to 2019, and they consumed less diesel fuel. Between 2020 and 2021, as a result of fleet turn-over, more off-road diesel engines were in compliance with the latest exhaust emission standards. Black carbon emissions from home firewood burning decreased by 9% (0.6 kt) between 2019 and 2020, and again in 2021(13% or 0.9 kt compared to 2019) consistent with increasingly warm winters.

Transportation and Mobile Equipment is by far the largest source of black carbon in Canada, accounting for 15 kt (56%) of total emissions in 2021. Of the various sources in this category, off-road diesel engines account for 8.9 kt (34%) of total emissions in 2021. The other large source in this category is diesel engines used for on-road transport, which account for 2.4 kt (9.1%) of total emissions.

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

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

Table ES–1 **Canadian Black Carbon Emissions by Source Category and Sector (2013 to 2021)**

Source Category and Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
ORE AND MINERAL INDUSTRIES	**650**	**620**	**570**	**540**	**670**	**580**	**610**	**520**	**570**
Aluminium Industry	51	45	36	35	34	30	30	33	34
Cement and Concrete Industry	14	15	19	15	16	20	17	13	19
Foundries[a]	0.11	0.16	0.13	0.10	0.13	0.10	0.10	0.10	0.15
Iron and Steel Industry	120	120	120	120	120	140	130	110	100
Iron Ore Pelletizing	6.3	6.6	7.1	7.3	6.3	5.7	6.5	5.5	5.1
Mining and Rock Quarrying	460	430	380	370	490	390	420	360	410
OIL AND GAS INDUSTRY	**2 600**	**3 000**	**2 800**	**2 400**	**2 500**	**2 600**	**2 500**	**2 500**	**2 700**
Disposal and Waste Treatment	0.12	0.13	0.13	0.12	0.12	0.10	0.10	0.10	0.10
Flaring	1 500	1 800	1 600	1 200	1 300	1 300	1 200	1 300	1 400
Heavy Crude Oil Cold Production	94	96	99	96	97	100	100	89	91
Light/Medium Crude Oil Production	160	160	160	150	150	160	160	150	150
Natural Gas Production and Processing	530	540	540	530	530	530	530	500	500
Natural Gas Transmission and Storage	34	32	32	32	33	33	33	33	33
Natural Gas Distribution	0.82	0.74	0.70	0.71	0.73	0.72	0.70	0.47	0.55
Oil Sands In-Situ Extraction	140	120	120	130	130	170	190	170	180
Oil Sands Mining, Extraction and Upgrading	200	310	250	250	290	280	270	280	340
Petroleum Liquids Storage	3.4	3.1	3.0	2.7	2.4	4.8	6.7	3.4	7.6
Petroleum Liquids Transportation	3.9	3.9	3.9	4.1	3.6	3.8	4.2	3.7	4.0
Well Drilling/Servicing/Testing	3.0	2.9	1.3	0.89	1.4	1.4	1.1	0.62	1.0
ELECTRIC POWER GENERATION (UTILITIES)	**210**	**230**	**240**	**240**	**210**	**220**	**210**	**200**	**190**
Coal	37	42	39	37	37	36	30	25	20
Natural Gas	12	11	11	9.7	8.5	8.7	7.4	7.4	8.0
Diesel	130	150	160	160	130	150	150	140	130
Other (Electric Power Generation)	25	29	29	31	27	28	28	28	25
MANUFACTURING	**490**	**390**	**410**	**330**	**290**	**280**	**290**	**290**	**290**
Pulp and Paper Industry	270	220	200	180	170	160	150	150	140
Wood Products	230	170	210	140	130	120	140	140	150
TRANSPORTATION AND MOBILE EQUIPMENT	**24 000**	**22 000**	**21 000**	**19 000**	**19 000**	**19 000**	**17 000**	**15 000**	**15 000**
Air Transportation (LTO)	230	220	210	210	210	230	230	140	160
Domestic Marine Navigation, Fishing and Military	820	720	610	630	620	630	700	550	630
On-Road Transport	7 300	6 700	5 500	4 300	3 800	3 700	3 300	2 900	3 000
Diesel	6 900	6 300	5 100	3 900	3 300	3 100	2 700	2 400	2 400
Gasoline	410	400	430	460	490	560	630	550	600
Liquid Petroleum Gas	0.49	0.39	0.38	0.31	0.34	0.40	0.47	0.49	0.58
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.10
Off-Road Transport	14 000	13 000	13 000	12 000	13 000	13 000	12 000	10 000	9 600
Diesel	13 000	12 000	12 000	12 000	12 000	12 000	11 000	9 400	8 900
Gasoline, Liquid Petroleum Gas and Natural Gas	890	800	780	810	780	760	750	680	700
Rail Transportation	1 900	1 700	1 500	1 300	1 400	1 500	1 400	1 200	1 200
AGRICULTURE	**46**	**46**	**42**	**42**	**40**	**34**	**33**	**27**	**25**
Agricultural Fuel Combustion	46	46	42	42	40	34	33	27	25
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	**9 000**	**9 100**	**8 700**	**8 300**	**8 300**	**8 800**	**8 700**	**8 000**	**7 700**
Commercial and Institutional Fuel Combustion	830	880	840	890	970	1 000	1 100	1 000	1 000
Construction Fuel Combustion	42	41	41	43	44	47	49	47	48
Home Firewood Burning	8 000	8 000	7 700	7 200	7 200	7 600	7 400	6 800	6 500
Fireplaces	900	870	800	730	700	830	900	820	780
Furnaces	5 100	5 100	4 900	4 700	4 800	4 800	4 400	4 000	3 800
Wood Stoves	2 000	2 000	1 900	1 700	1 600	2 000	2 200	2 000	1 900
Residential Fuel Combustion	160	160	150	140	150	150	150	140	140
TOTAL	**37 000**	**35 000**	**34 000**	**31 000**	**31 000**	**31 000**	**30 000**	**26 000**	**26 000**

Notes:
Totals may not add up due to rounding.
Values in this report have been rounded to two significant digits.
a. The Foundries sector is being considered for omission from future inventories. If you have any questions, please contact us at apei-iepa@ec.gc.ca or 1-877-877-8375.
0.00 Indicates emissions were truncated due to rounding.

Other Emissions Estimated in the Black Carbon Inventory

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Domestic Air Transportation (Cruise)	230	220	210	210	230	250	250	140	160
International Air Transportation (Cruise)	370	360	370	380	420	480	490	220	230
International Marine Navigation	1 200	1 100	1 000	1 000	1 000	1 100	900	700	750

Note: Refer to Annex 3.3 for more information on Transportation and Mobile Equipment emissions reporting.

Commercial/Residential/Institutional fuel combustion is the second-largest contributor to black carbon emissions in Canada, accounting for 7.7 kt of black carbon, or 30% of total emissions in 2021. Home Firewood Burning is the largest source in this category, making up 6.5 kt of black carbon, or 25% of total 2021 emissions. Wood is an abundant fuel source in Canada, and it is estimated that 6.2 million tonnes of firewood were burned in Canadian homes in 2021, a decrease of 28% since 2015 (StatCan, n.d.).

Since 2013, black carbon emissions in Canada have decreased overall by 11 kt (30%). Therefore, Canada has already achieved its share of the Arctic Council's goal to reduce black carbon emissions by 25-33% below 2013 levels by 2025.[3] Trends in black carbon emissions are largely driven by the Transportation and Mobile Equipment category and are consistent with observed trends in emissions of PM less than or equal to 2.5 microns in diameter ($PM_{2.5}$) (on which black carbon estimates are based) (Table ES–1). More information on black carbon emissions and trends in Canada can be found in Chapter 2, and on estimation methods, in Chapter 3.

Irrespective of the downward trend, air quality issues may still arise when emission sources are spatially concentrated. While the black carbon inventory provides valuable information on emissions in Canada, it does not distinguish localized sources of emissions within the provincial and territorial level aggregations. Work will continue to improve the completeness and accuracy of the inventory, quantifying the emissions that are not yet captured, and refining base data and estimation techniques.

3 Recognizing that the Arctic Council goal to reduce black carbon is a collective goal, achievement of this goal for the Arctic Council writ large would require parallel reductions from all Arctic States.

INTRODUCTION

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

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

Canada's Black Carbon Inventory Report is an inventory of black carbon emissions at the national, provincial, and territorial levels. The report is prepared and published by Environment and Climate Change Canada (ECCC) and is compiled from many different data sources. It contributes to the tracking and quantifying of black carbon emissions. This document describes the 2023 edition of Canada's annual inventory of anthropogenic black carbon emissions, covering the years from 2013 to 2021. All emissions reported in this inventory are from anthropogenic (human) sources. Natural sources of black carbon, such as wildfires, are not included. Emissions are generally grouped in the same categories as those used in Canada's Air Pollutant Emissions Inventory (APEI). They are organized into seven source categories that are further broken down into 34 sectors and nine associated subsectors. See Annex 1 for source category organization and sector descriptions.

The estimates in this inventory are based on the best available information at the time of compilation. Estimates of $PM_{2.5}$ emissions are consistent with those reported in Canada's 2023 APEI. Please refer to Chapter 3 and Annex 2 of the APEI report (Environment and Climate Change Canada [ECCC], 2023) for a description of the inventory development and estimation methods for $PM_{2.5}$. While the black carbon inventory provides valuable information on emissions in Canada, it does not distinguish localized sources of emissions within the provincial and territorial level aggregations. Work will continue to improve the quality, completeness, and accuracy of the inventory while quantifying the emissions that are not yet captured, and refining base data and estimation techniques. See Chapter 3 of the present report for more information on the black carbon inventory development.

CHAPTER 2

BLACK CARBON EMISSIONS AND TRENDS IN CANADA

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

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

For each of these categories, emissions are further split into sectors.[1] In keeping with international reporting requirements, Canada's emissions of black carbon from aircraft at cruising altitude, as well as emissions from international marine navigation, are presented separately from other emission sources in this report and are excluded from Canada's national total emissions.

In 2021, approximately 26 kilotonnes (kt) of black carbon were emitted in Canada (Table 2–1). The most recent years for which data are available for this report, 2020 and 2021, were marked by the COVID-19 pandemic, coinciding with observed decreases in emissions of 3.4 kt or 11% between 2019 and 2020 and 0.43 kt or 1.7% between 2020 and 2021. This is most notable in Transportation and Mobile Equipment where emissions decreased 2.6 kt or 15% between 2019 and 2020 and 0.31 kt or 2.1% between 2020 and 2021, mostly from off-road diesel equipment. There were less off-road diesel engines in use in 2020 relative to 2019, and they consumed less diesel fuel. Between 2020 and 2021, as a result of fleet turn-over, more off-road diesel engines were in compliance with the latest exhaust emission standards. Black carbon emissions from home firewood burning decreased by 9% (0.6 kt) between 2019 and 2020, and again in 2021 (13% or 0.9 kt compared to 2019) consistent with increasingly warm winters.

The Transportation and Mobile Equipment category is by far the largest source of black carbon in Canada, accounting for 15 kt (56%) of total emissions in 2021. Of the various sources in this category, off-road diesel engines account for 8.9 kt (34%) of total emissions in 2021. The other large source in this category is diesel engines used for on-road transport, which account for 2.4 kt (9.1%) of total emissions.

The Commercial/Residential/Institutional category is the second-largest contributor to black carbon emissions in Canada, making up 7.7 kt or 30% of total emissions in 2021. Home Firewood Burning is the largest source in this category, accounting for 6.5 kt or 25% of total emissions. Wood is an abundant fuel source in Canada, and it is estimated that 6.2 million tonnes of firewood were burned in Canadian homes in 2021, a decrease of 28% since 2015 (StatCan, n.d.).

1 See Annex 1 for sector descriptions.

Table 2–1 **Black Carbon Emissions in Canada (2021)**

Source Category, Sector and Subsector	Black Carbon (tonnes)	Percentage of Total
ORE AND MINERAL INDUSTRIES	**570**	**2.2%**
Aluminium Industry	34	0.1%
Cement and Concrete Industry	19	0.1%
Foundries[a]	0.15	0.0%
Iron and Steel Industry	100	0.4%
Iron Ore Pelletizing	5.1	0.0%
Mining and Rock Quarrying	410	1.6%
OIL AND GAS INDUSTRY	**2 700**	**10%**
Disposal and Waste Treatment	0.10	0.0%
Flaring	1 400	5.4%
Heavy Crude Oil Cold Production	91	0.4%
Light/Medium Crude Oil Production	150	0.6%
Natural Gas Production and Processing	500	1.9%
Natural Gas Transmission and Storage	33	0.1%
Natural Gas Distribution	0.55	0.0%
Oil Sands In-Situ Extraction	180	0.7%
Oil Sands Mining, Extraction and Upgrading	340	1.3%
Petroleum Liquids Storage	7.6	0.0%
Petroleum Liquids Transportation	4.0	0.0%
Well Drilling/Servicing/Testing	1.0	0.0%
ELECTRIC POWER GENERATION (UTILITIES)	**190**	**0.7%**
Coal	20	0.1%
Diesel	130	0.5%
Natural Gas	8.0	0.0%
Other (Electric Power Generation)	25	0.1%
MANUFACTURING	**290**	**1.1%**
Pulp and Paper Industry	140	0.5%
Wood Products	150	0.6%
TRANSPORTATION AND MOBILE EQUIPMENT	**15 000**	**58%**
Air Transportation (LTO)	160	0.6%
Domestic Marine Navigation, Fishing and Military	630	2.4%
On-Road Transport	3 000	12%
Diesel	2 400	9%
Gasoline	600	2.3%
Liquid Petroleum Gas	0.58	0.0%
Natural Gas	0.10	0.0%
Off-Road Transport	9 600	37%
Diesel	8 900	34%
Gasoline, Liquid Petroleum Gas and Natural Gas	700	2.7%
Rail Transportation	1 200	4.6%
AGRICULTURE	**25**	**0.1%**
Agricultural Fuel Combustion	25	0.1%
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	**7 700**	**30%**
Commercial and Institutional Fuel Combustion	1 000	3.8%
Construction Fuel Combustion	48	0.2%
Home Firewood Burning	6 500	25%
Fireplaces	780	3.0%
Furnaces	3 800	15%
Wood Stoves	1 900	7.3%
Residential Fuel Combustion	140	0.5%
TOTAL	**26 000**	**100%**

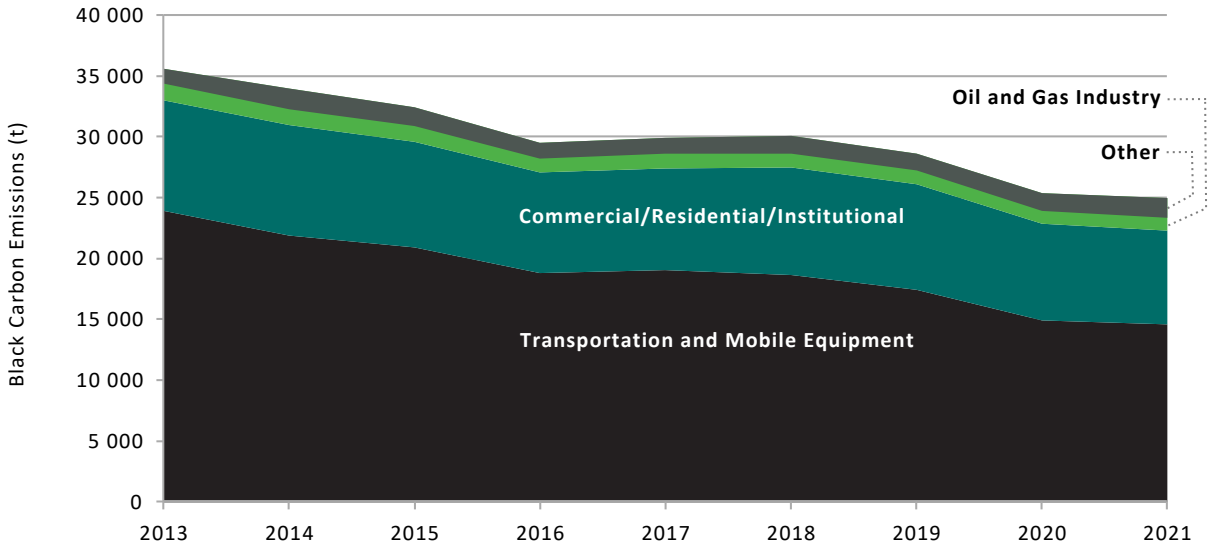
Notes:
Totals may not add up due to rounding.
Values in this report have been rounded to two significant digits.
a. The Foundries sector is being considered for omission from future inventories. If you have any questions, please contact us at apei-iepa@ec.gc.ca or 1-877-877-8375.
0.00 Indicates emissions were truncated due to rounding.

Other emissions estimated in the black carbon inventory

Sector	Black Carbon (tonnes)	Percentage of total
Domestic Air Transportation (Cruise)	160	14%
International Air Transportation (Cruise)	230	20%
International Marine Navigation	750	66%

Note: Refer to Annex 3.3 for more information on Transportation and Mobile Equipment emissions reporting.

Figure 2–1 **Trends in Canadian Black Carbon Emissions (2013 to 2021)**



Since 2013, black carbon emissions in Canada have decreased overall by 11 kt (30%) in 2021 (Figure 2–1).Trends in black carbon emissions are largely driven by the Transportation and Mobile Equipment category and are consistent with observed trends in emissions of PM less than or equal to 2.5 microns in diameter ($PM_{2.5}$) (on which black carbon estimates are based). Details on each of the source categories and their associated sectors can be found in sections 2.1 to 2.7. An overview of the methods used to develop the black carbon inventory, improvements applied to this edition of the inventory, sources of uncertainty and future refinements are described in Chapter 3. Provincial and territorial estimates of black carbon emissions are provided in section 2.8 and Annex 4.

2.1. Ore and Mineral Industries

Sources in the Ore and Mineral Industries category include primary resource extraction and processing (Table 2–2, Table 2–3 and Figure 2–2)[2]. For the purpose of this inventory, black carbon emissions were considered for the following industries:

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

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

Of all sources in the Ore and Mineral Industries category included in this inventory, the Mining and Rock Quarrying sector accounted for the largest proportion (1.6% or 0.41 kt) of total black carbon emissions in 2021 (Figure 2–2). Black carbon emissions from Mining and Rock Quarrying remained relatively stable since 2013, ranging between 0.36 and 0.49 kt. The use of diesel to generate electricity at remote mines in northern areas, combined with the relatively high BC/$PM_{2.5}$ fraction for diesel relative to other fuels, is a significant contributor to this sector.

The second-largest source of black carbon emissions in the Ore and Mineral Industries category is the Iron and Steel Industry, which accounted for 0.10 kt or 0.4% of total black carbon emissions in 2021. Emissions from this sector have decreased by 12% since 2013. This is mainly due to a reduction in $PM_{2.5}$ emissions from one facility, which updated its estimation methodology.

2 Since black carbon originates predominantly from particulate matter less than or equal to 2.5 microns in diameter (PM2.5) emitted from combustion, the black carbon emissions are presented along with the combustion PM2.5 emissions for each category in respective tables.

The Aluminium Industry sector emitted 0.034 kt of black carbon, or 0.1% of the national total, a decrease of 0.017 kt or 34% since 2013. The decrease can be attributed to the closures of the last three Søderberg aluminium smelters between 2013 and 2015.[3]

Table 2–2 Black Carbon Emissions from Ore and Mineral Industries (2013 to 2021)

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Aluminium Industry	51	45	36	35	34	30	30	33	34
Cement and Concrete Industry	14	15	19	15	16	20	17	13	19
Foundries[a]	0.11	0.16	0.13	0.10	0.13	0.10	0.10	0.10	0.15
Iron and Steel Industry	120	120	120	120	120	140	130	110	100
Iron Ore Pelletizing	6.3	6.6	7.1	7.3	6.3	5.7	6.5	5.5	5.1
Mining and Rock Quarrying	460	430	380	370	490	390	420	360	410
TOTAL	**650**	**620**	**570**	**540**	**670**	**580**	**610**	**520**	**570**

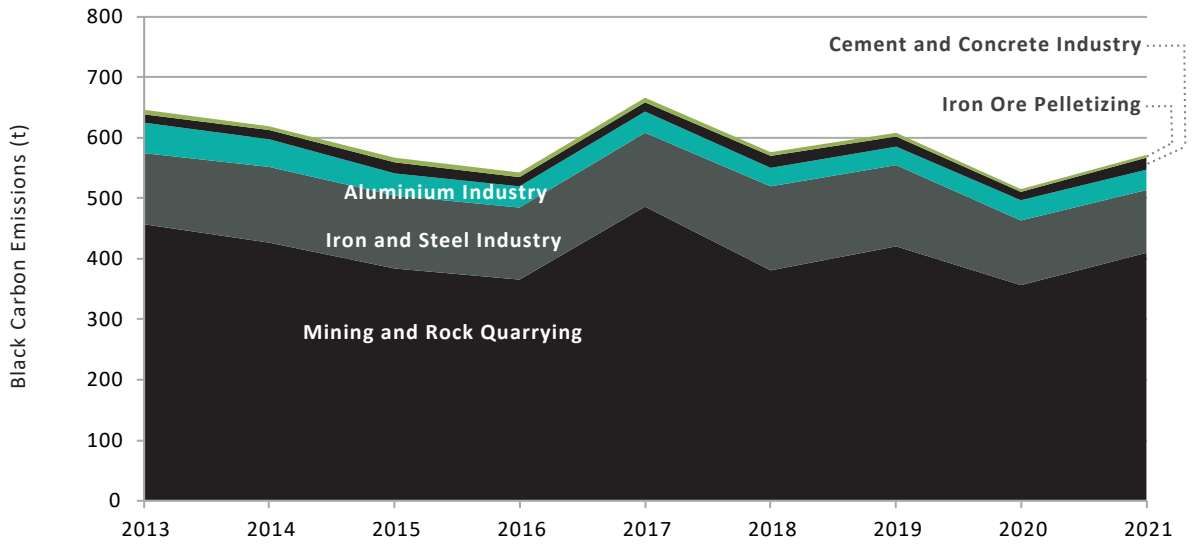
Notes:
Totals may not add up due to rounding.
Values in this report have been rounded to two significant digits.
a. The Foundries sector is being considered for omission from future inventories. If you have any questions, please contact us at apei-iepa@ec.gc.ca or 1-877-877-8375.
0.00 Indicates emissions were truncated due to rounding.

Table 2–3 $PM_{2.5}$ Emissions from Combustion in Ore and Mineral Industries (2013 to 2021)

Sector	$PM_{2.5}$ from combustion (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Aluminium Industry	2 300	2 100	1 700	1 600	1 600	1 400	1 400	1 500	1 500
Cement and Concrete Industry	740	800	950	800	790	940	850	660	860
Foundries[a]	12	17	14	8.7	14	11	9.3	6.0	17
Iron and Steel Industry	1 700	2 100	1 900	1 800	2 200	2 300	2 400	1 900	2 000
Iron Ore Pelletizing	730	760	820	850	730	660	750	640	590
Mining and Rock Quarrying	2 400	1 900	1 500	1 500	1 700	1 800	2 100	2 100	2 300
TOTAL	**7 900**	**7 700**	**6 800**	**6 600**	**7 000**	**7 200**	**7 400**	**6 900**	**7 300**

Notes:
Totals may not add up due to rounding.
Values in this report have been rounded to two significant digits.
a. The Foundries sector is being considered for omission from future inventories. If you have any questions, please contact us at apei-iepa@ec.gc.ca or 1-877-877-8375.
0.00 Indicates emissions were truncated due to rounding.

Figure 2–2 Trends in Canadian Black Carbon Emissions from Ore and Mineral Industries (2013 to 2021)



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

2.2. Oil and Gas Industry

The Oil and Gas Industry accounted for 2.7 kt or 10% of all black carbon emitted in 2021. The main sources of black carbon emissions in the Oil and Gas Industry include fuel combustion to power pumps, engines and heaters and natural gas flaring. (Table 2–4, Table 2–5 and Figure 2–3). Black carbon emissions from fuel combustion are broken down by the sectors presented below. While flaring occurs in most oil and gas sectors, it is presented separately since it is a significant source of black carbon emissions.

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

Since 2013, black carbon emissions from the Oil and Gas industry have increased by 0.04 kt or 1.4%. Of all Oil and Gas sectors included in this inventory, Flaring accounted for the largest proportion (5% or 1.4 kt) of total black carbon emissions in 2021 (Figure 2–3). Emissions from this sector decreased by 0.01 kt or 6.6% between 2013 and 2021. Emissions from flaring are directly related to volumes of gas flared in the industry and vary from year to year due to a variety of factors. For example, federal and provincial regulations came into force in 2020 to reduce methane emissions from the oil and gas industry. Since methane is a potent greenhouse gas, flaring is preferred to venting as it reduces emissions of methane and non-methane volatile organic compounds by converting them to carbon dioxide through combustion. It does, however, increase emissions of black carbon as well as carbon monoxide, $PM_{2.5}$, and nitrogen oxides. In response to the regulations, the volume of gas flared increased between 2019 and 2021, resulting in a 12% increase in black carbon emissions from flaring over the same period.

The next two largest sources of black carbon emissions in this category are Natural Gas Production and Processing, which accounted for 0.50 kt or 1.9% of total black carbon emissions, and Oil Sands Mining, Extraction and Upgrading, which accounted for 0.34 kt or 1.3% of total black carbon emissions. Since 2013, black carbon emissions have increased from Oil Sands Mining, Extraction and Upgrading and from Oil Sands In-Situ Extraction by a combined total of 0.18 kt (52%). This is consistent with a 63% increase in crude bitumen production from mining operations and a 81% increase in crude bitumen production from in-situ thermal extraction facilities, both of which contribute to increased fuel combustion and flaring activities.

Table 2–4 **Black Carbon Emissions from the Oil and Gas Industry (2013 to 2021)**

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Disposal and Waste Treatment	0.12	0.13	0.13	0.12	0.12	0.10	0.10	0.10	0.10
Flaring	1 500	1 800	1 600	1 200	1 300	1 300	1 200	1 300	1 400
Heavy Crude Oil Cold Production	94	96	99	96	97	100	100	89	91
Light/Medium Crude Oil Production	160	160	160	150	150	160	160	150	150
Natural Gas Production and Processing	530	540	540	530	530	530	530	500	500
Natural Gas Transmission and Storage	34	32	32	32	33	33	33	33	33
Natural Gas Distribution	0.82	0.74	0.70	0.71	0.73	0.72	0.70	0.47	0.55
Oil Sands In-Situ Extraction	140	120	120	130	130	170	190	170	180
Oil Sands Mining, Extraction and Upgrading	200	310	250	250	290	280	270	280	340
Petroleum Liquids Storage	3.4	3.1	3.0	2.7	2.4	4.8	6.7	3.4	7.6
Petroleum Liquids Transportation	3.9	3.9	3.9	4.1	3.6	3.8	4.2	3.7	4.0
Well Drilling/Servicing/Testing	3.0	2.9	1.3	0.89	1.4	1.4	1.1	0.62	1.0
TOTAL	**2 600**	**3 000**	**2 800**	**2 400**	**2 500**	**2 600**	**2 500**	**2 500**	**2 700**

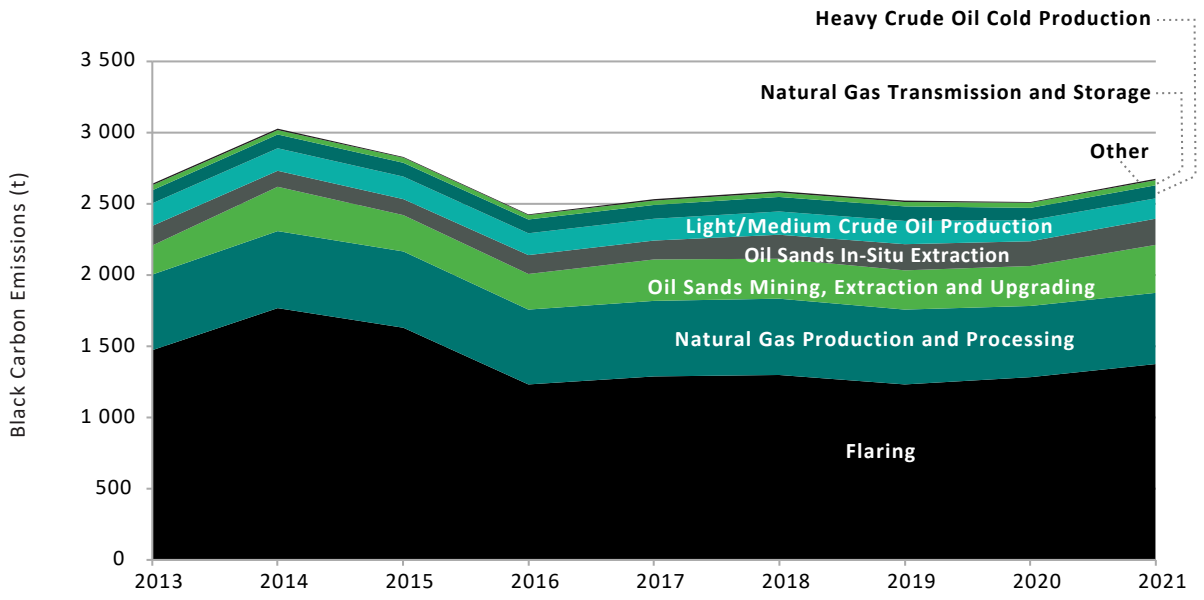
Notes:
Totals may not add up due to rounding.
Values in this report have been rounded to two significant digits.

Table 2–5 **$PM_{2.5}$ Emissions from Combustion in the Oil and Gas Industry (2013 to 2021)**

Sector	$PM_{2.5}$ from combustion (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Disposal and Waste Treatment	0.30	0.34	0.33	0.30	0.30	0.27	0.23	0.18	0.16
Flaring	5 200	6 100	5 900	5 000	5 600	5 200	5 100	5 600	7 200
Heavy Crude Oil Cold Production	160	170	170	160	170	170	170	150	160
Light/Medium Crude Oil Production	300	300	290	290	290	300	300	280	270
Natural Gas Production and Processing	1 400	1 400	1 400	1 300	1 300	1 400	1 300	1 300	1 300
Natural Gas Transmission and Storage	88	83	84	84	85	87	87	87	87
Natural Gas Distribution	2.1	1.9	1.8	1.8	1.9	1.9	1.8	1.2	1.4
Oil Sands In-Situ Extraction	360	300	300	330	340	440	480	440	470
Oil Sands Mining, Extraction and Upgrading	1 300	2 200	1 600	1 700	1 900	1 900	1 800	1 900	2 400
Petroleum Liquids Storage	9.0	8.1	7.9	6.9	6.1	13	17	8.8	20
Petroleum Liquids Transportation	10	10	10	11	9.3	9.8	11	9.5	10
Well Drilling/Servicing/Testing	3.9	3.8	1.7	1.2	1.9	1.9	1.4	0.81	1.3
TOTAL	**8 800**	**11 000**	**9 700**	**8 900**	**9 800**	**9 400**	**9 400**	**9 800**	**12 000**

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 the Oil and Gas Industry (2013 to 2021)**



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

Electric Power Generation (Utilities) accounted for 0.19 kt (0.7%) of all black carbon emissions in 2021 (Table 2–6, Table 2–7 and Figure 2–4) with a 0.02 kt (20 %) decrease in emissions since 2013. Black carbon emissions from this source category are relatively low. Large facilities using solid fuels are equipped with particulate controls, while boilers and heaters using liquid and gaseous fuels emit limited particulate matter. There is relatively little diesel fuel used in large stationary electricity generation applications.

Coverage for this source category is nearly complete; the remaining 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 low nationally, can have important regional atmospheric and air quality impacts in areas such as Canada's North.

The largest emitter of black carbon in this category is Diesel electric power generation, which accounted for 0.13 kt (0.5 %) of total black carbon emissions in 2021, and over 70% of the black carbon in this category. The trend is largely influenced by fluctuations in diesel-fired electricity generation. In 2021, black carbon emissions from diesel-fired electric power generation remained stable from their 2013 level; but the influence of diesel on the category increased so it represents 72% of emissions in 2020 (up from 64%). Black carbon emissions decreased between 2013 and 2021 for both Coal and Natural Gas electric power generation. The reduction in emissions from coal-fired electricity generation is due to the coal plant closures in Ontario and reduced coal consumption in Alberta, while reductions in emissions from natural gas-fired electricity generation is due to increased generation from renewable sources.

Table 2–6 **Black Carbon Emissions from Electric Power Generation (Utilities) (2013 to 2021)**

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Coal	37	42	39	37	37	36	30	25	20
Diesel	130	150	160	160	130	150	150	140	130
Natural Gas	12	11	11	9.7	8.5	8.7	7.4	7.4	8.0
Other (Electric Power Generation)	25	29	29	31	27	28	28	28	25
TOTAL	**210**	**230**	**240**	**240**	**210**	**220**	**210**	**200**	**190**

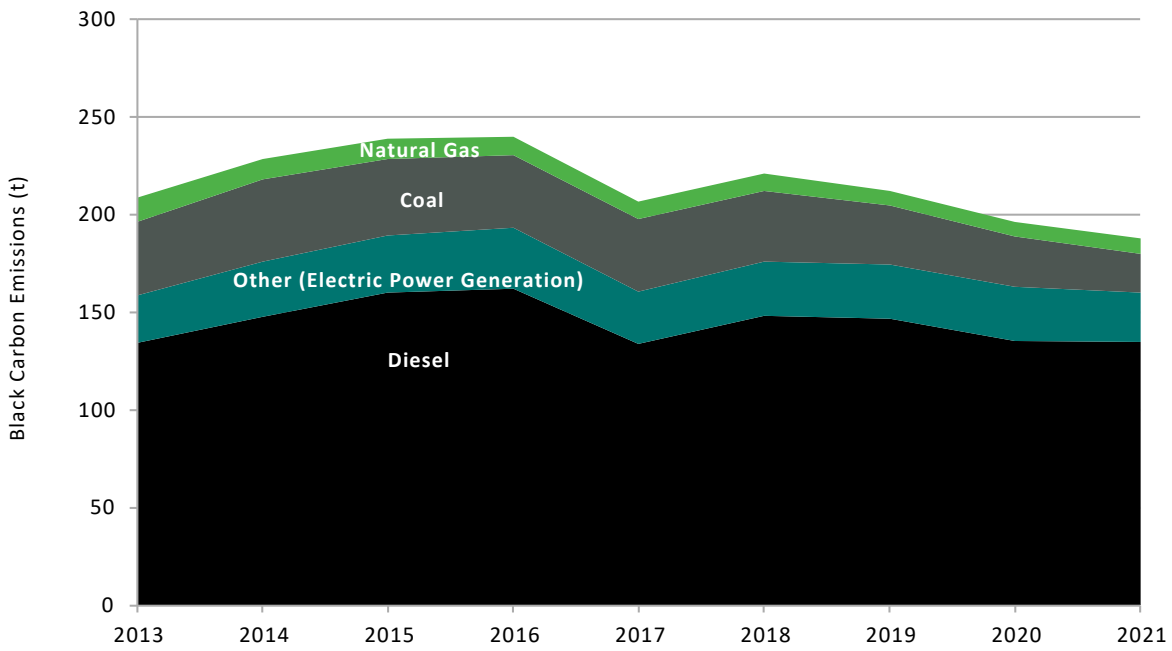
Notes:
Totals may not add up due to rounding.
Values in this report have been rounded to two significant digits.

Table 2–7 **$PM_{2.5}$ Emissions from Combustion in Electric Power Generation (Utilities) (2013 to 2021)**

Sector	$PM_{2.5}$ from combustion (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Coal	2 200	2 500	2 300	2 200	2 200	2 100	1 800	1 500	1 200
Diesel	170	190	210	210	170	190	190	180	170
Natural Gas	500	420	420	390	340	350	300	300	320
Other (Electric Power Generation)	290	410	410	500	490	410	420	390	310
TOTAL	**3 200**	**3 500**	**3 400**	**3 300**	**3 200**	**3 100**	**2 700**	**2 400**	**2 000**

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 2021)**



2.4. Manufacturing

Manufacturing sources include the Pulp and Paper Industry and Wood Products sectors (Table 2–8 and Table 2–9), which accounted for 0.29 kt or 1.1% of total black carbon emissions in 2021. 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 2021 (0.20 kt or 41%) is largely consistent with reduced production in both the Pulp and Paper Industry and Wood Products sectors.

Table 2–8 **Black Carbon Emissions from Manufacturing (2013 to 2021)**

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Pulp and Paper Industry	270	220	200	180	170	160	150	150	140
Wood Products	230	170	210	140	130	120	140	140	150
TOTAL	**490**	**390**	**410**	**330**	**290**	**280**	**290**	**290**	**290**

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

Table 2–9 **$PM_{2.5}$ Emissions from Combustion in Manufacturing (2013 to 2021)**

Sector	$PM_{2.5}$ from combustion (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Pulp and Paper Industry	8 200	7 600	6 900	6 300	5 800	5 400	5 000	5 100	4 600
Wood Products	3 200	2 500	2 800	2 100	1 900	1 900	2 300	2 300	2 400
TOTAL	**11 000**	**10 000**	**9 700**	**8 500**	**7 800**	**7 200**	**7 300**	**7 400**	**7 000**

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

2.5. Transportation and Mobile Equipment

Transportation and Mobile Equipment includes black carbon emissions from Air Transportation (Landing and Takeoff [LTO]), Domestic Marine Navigation, Fishing and Military, On-Road and Off-Road Transport (diesel, gasoline, liquid petroleum gas and natural gas) and Rail Transportation sectors (Table 2–10, Table 2–11 and Figure 2–5). Off-Road Transport is a highly diverse sector that includes lawn and garden equipment; recreational vehicles(e.g., pleasure craft and snowmobiles); farm, construction and mining equipment; and portable generators and pumps. Both on-road and off-road diesel engines are subject to emission standards for PM and are equipped with sophisticated emission controls to reduce PM emissions. As more engines within Canada's vehicle population are equipped with this technology PM emission rates are expected to decrease which in turn will reduce black carbon emissions.

The Transportation and Mobile Equipment category is by far the largest source of anthropogenic black carbon from combustion in Canada, accounting for 15 kt (56%) of total emissions in 2021 (Table 2–1). An important source in this category is mobile diesel engines, both on-road and off-road, which emit significant quantities of $PM_{2.5}$ and have the highest $BC/PM_{2.5}$ ratios of all black carbon sources. As a result, mobile diesel engines account for nearly all emissions from this category, and 43% of total black carbon emissions in 2021. The implementation of effective fuel and engine regulations for on-road and off-road diesel, in addition to reduced on-road diesel fuel consumption, resulted in decreases to on-road and off-road diesel emissions between 2013 and 2021 by 66% (4.6 kt) and 30% (3.9 kt) respectively, contributing to a 43% decrease overall. The remaining black carbon emissions from Transportation and Mobile Equipment come from air, marine, non-diesel on- and off-road transport, and rail transportation, which accounted for 3.3 kt and 13% of the total black carbon emitted in 2021.

Coinciding with the COVID-19 pandemic, black carbon emissions from Transportation and Mobile Equipment decreased by 2.6 kt or 15% between 2019 and 2020 and 0.32 kt or 2.1% between 2020 and 2021, mostly from off-road diesel equipment. These equipment were collectively used less in 2020 relative to 2019, resulting in less diesel fuel consumed and less black carbon emitted. Between 2020 and 2021, as a result of fleet turn-over, more off-road diesel equipment were in compliance with the latest exhaust emission standards, resulting in decreased black carbon emissions despite increased diesel fuel consumption. For Air Transportation [LTO], emissions decreases by 0.08 kt or 37% between 2019 and 2020 linked with a decrease in air traffic. Between 2020 and 2021, emission increased by 0.02 kt or 14%.

Table 2–10 **Black Carbon Emissions from Transportation and Mobile Equipment (2013 to 2021)**

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Air Transportation (LTO)	230	220	210	210	210	230	230	140	160
Domestic Marine Navigation, Fishing and Military	820	720	610	630	620	630	700	550	630
On-Road Transport	7 300	6 700	5 500	4 300	3 800	3 700	3 300	2 900	3 000
Diesel	6 900	6 300	5 100	3 900	3 300	3 100	2 700	2 400	2 400
Gasoline	410	400	430	460	490	560	630	550	600
Liquid Petroleum Gas	0.49	0.39	0.38	0.31	0.34	0.40	0.47	0.49	0.58
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.10
Off-Road Transport	14 000	13 000	13 000	12 000	13 000	13 000	12 000	10 000	9 600
Diesel	13 000	12 000	12 000	12 000	12 000	12 000	11 000	9 400	8 900
Gasoline, Liquid Petroleum Gas and Natural Gas	890	800	780	810	780	760	750	680	700
Rail Transportation	1 900	1 700	1 500	1 300	1 400	1 500	1 400	1 200	1 200
TOTAL	**24 000**	**22 000**	**21 000**	**19 000**	**19 000**	**19 000**	**17 000**	**15 000**	**15 000**

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	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Domestic Air Transportation (Cruise)	230	220	210	210	230	250	250	140	160
International Air Transportation (Cruise)	370	360	370	380	420	480	490	220	230
International Marine Navigation	1 200	1 100	1 000	1 000	1 000	1 100	900	700	750

Note:
Refer to Annex 3.3 for more information.

Table 2–11 **$PM_{2.5}$ Emissions from Combustion in Transportation and Mobile Equipment (2013 to 2021)**

Sector	$PM_{2.5}$ from combustion (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Air Transportation (LTO)	300	280	280	270	280	300	290	180	210
Domestic Marine Navigation, Fishing and Military	2 300	1 700	1 000	1 100	1 200	1 100	1 100	1 000	1 200
On-Road Transport	12 000	11 000	9 300	7 400	6 500	6 300	5 700	5 100	5 100
Diesel	11 000	9 800	8 000	6 100	5 300	4 900	4 300	3 800	3 800
Gasoline	1 300	1 300	1 300	1 300	1 300	1 400	1 400	1 200	1 300
Liquid Petroleum Gas	1.9	1.4	1.3	1.0	1.0	1.2	1.4	1.3	1.6
Natural Gas	0.40	0.45	0.39	0.38	0.43	0.38	0.45	0.45	0.49
Off-Road Transport	23 000	21 000	22 000	21 000	22 000	21 000	20 000	17 000	17 000
Diesel	16 000	15 000	16 000	15 000	15 000	15 000	14 000	12 000	11 000
Gasoline, Liquid Petroleum Gas and Natural Gas	7 300	6 500	6 400	6 700	6 400	6 200	6 200	5 600	5 800
Rail Transportation	2 400	2 200	1 900	1 700	1 800	2 000	1 800	1 600	1 500
TOTAL	**41 000**	**37 000**	**34 000**	**32 000**	**32 000**	**31 000**	**29 000**	**25 000**	**25 000**

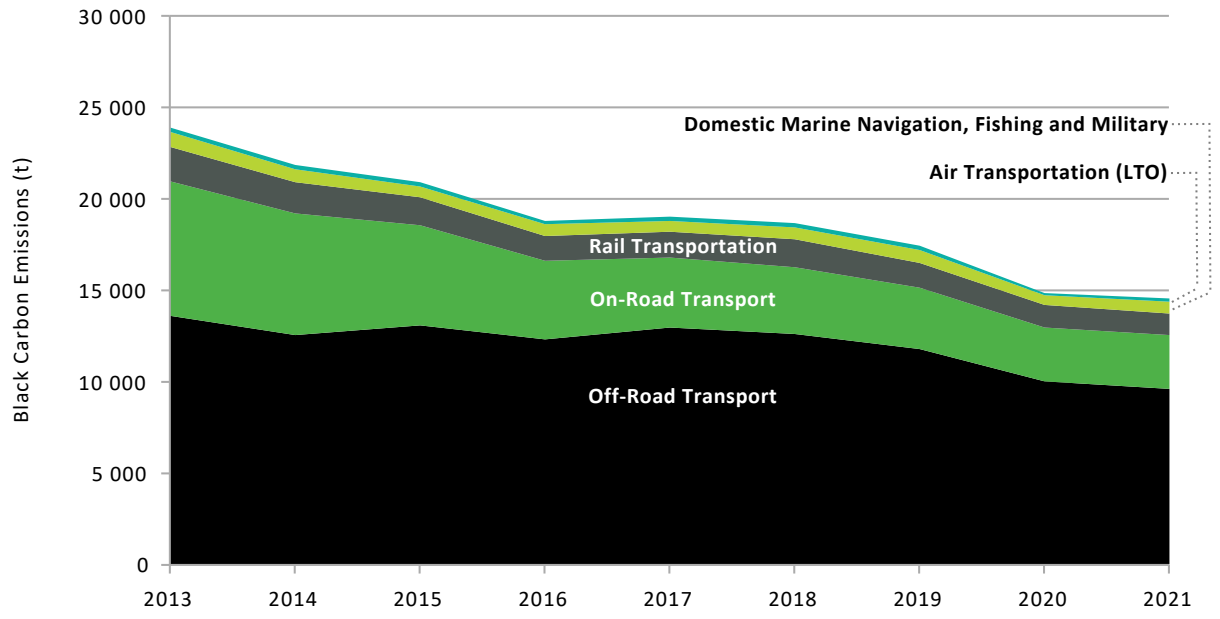
Notes:
Totals may not add up due to rounding.
Values in this report have been rounded to two significant digits.

Other Emissions Estimated in the Black Carbon Inventory

Sector	$PM_{2.5}$ from combustion (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Domestic Air Transportation (Cruise)	290	280	280	280	300	320	330	180	210
International Air Transportation (Cruise)	480	470	480	500	540	620	640	290	300
International Marine Navigation	4 300	2 900	1 500	1 500	1 500	1 600	1 300	980	1 100

Note:
Refer to Annex 3.3 for more information.

Figure 2–5 **Trends in Canadian Black Carbon Emissions from Transportation and Mobile Equipment (2013 to 2021)**



2.6. Agriculture

Agriculture sources consist of Agricultural Fuel Use for non-mobile equipment (e.g., for drying grain, heating barns) and accounted for 0.025 kt (0.09%) of total black carbon emitted in 2021 (Table 2–12 and Table 2–13). Since 2013, emissions of black carbon from this source decreased by 0.021 kt or 47% in 2021. In 2013 and 2021, Alberta contributed 73% and 61%, respectively of the total black carbon emissions from fuel use. The decrease in black carbon emissions between 2013 and 2021 is a result of reduced coal consumption in non-mobile equipment in Alberta.

Table 2–12 **Black Carbon Emissions from Agriculture (2013 to 2021)**

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Agricultural Fuel Combustion	46	46	42	42	40	34	33	27	25
TOTAL	**46**	**46**	**42**	**42**	**40**	**34**	**33**	**27**	**25**

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

Table 2–13 **$PM_{2.5}$ Emissions from Combustion in Agriculture (2013 to 2021)**

Sector	$PM_{2.5}$ from combustion (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Agricultural Fuel Combustion	320	310	290	290	280	260	260	230	220
TOTAL	**320**	**310**	**290**	**290**	**280**	**260**	**260**	**230**	**220**

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

2.7. Commercial/Residential/Institutional Sources

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

Of all Commercial/Residential/Institutional sources, Home Firewood Burning accounted for the largest proportion (6.5 kt or 25%) of total black carbon emissions in 2021 (Table 2–14 and Table 2–15). Emissions from Home Firewood Burning are split into the following subsectors:

- Fireplaces
- Furnaces
- Wood Stoves

A key determinant of total emissions from Home Firewood Burning is the quantity of wood burned in each type of device (residential wood stoves, furnaces and fireplaces). The decreasing trend in this sector between 2013 and 2021 (1.5 kt or 19%) can be attributed in part to the reduction in the use of conventional fireplaces and wood stoves and their replacement with fireplace inserts, furnaces and stoves with improved emission controls and combustion efficiencies. Between 2019 and 2021, emissions from this source decreased by 0.94 kt or 13% due warmer heating seasons, as indicated by an 6% decrease in heating degree-days.

The next largest source of black carbon emissions in this category is Commercial and Institutional Fuel Combustion, which accounted for 1.0 kt (3.9%) of total black carbon emissions. Overall, the combustion of fuels, other than wood, accounted for 1.2 kt (4.6%) of total black carbon emissions from this category in 2021.

Table 2–14 **Black Carbon Emissions from Commercial/Residential/Institutional Sources (2013 to 2021)**

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Commercial and Institutional Fuel Combustion	830	880	840	890	970	1 000	1 100	1 000	1 000
Construction Fuel Combustion	42	41	41	43	44	47	49	47	48
Home Firewood Burning	8 000	8 000	7 700	7 200	7 200	7 600	7 400	6 800	6 500
Fireplaces	900	870	800	730	700	830	900	820	780
Furnaces	5 100	5 100	4 900	4 700	4 800	4 800	4 400	4 000	3 800
Wood Stoves	2 000	2 000	1 900	1 700	1 600	2 000	2 200	2 000	1 900
Residential Fuel Combustion	160	160	150	140	150	150	150	140	140
TOTAL	**9 000**	**9 100**	**8 700**	**8 300**	**8 300**	**8 800**	**8 700**	**8 000**	**7 700**

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

Table 2–15 **$PM_{2.5}$ Emissions from Combustion of Commercial/Residential/Institutional Sources (2013 to 2021)**

Sector	$PM_{2.5}$ from combustion (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Commercial and Institutional Fuel Combustion	2 300	2 400	2 300	2 400	2 600	2 700	2 800	2 700	2 700
Construction Fuel Combustion	120	120	120	120	120	130	130	130	130
Home Firewood Burning	89 000	89 000	85 000	79 000	77 000	85 000	86 000	79 000	75 000
Fireplaces	16 000	16 000	14 000	13 000	13 000	15 000	16 000	15 000	14 000
Furnaces	37 000	37 000	36 000	34 000	35 000	35 000	32 000	29 000	28 000
Wood Stoves	37 000	36 000	35 000	31 000	30 000	36 000	39 000	35 000	34 000
Residential Fuel Combustion	2 400	2 400	2 300	2 200	2 300	2 400	2 300	2 200	2 100
TOTAL	**94 000**	**94 000**	**90 000**	**83 000**	**82 000**	**90 000**	**92 000**	**84 000**	**80 000**

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

2.8. Provincial and Territorial Black Carbon Emissions Trends

This section describes black carbon emissions trends by Canadian provinces and territories for 2013 to 2021. Complete provincial and territorial estimates are provided in Annex 4.

Since 2013, black carbon emission trends in Canadian provinces and territories are mostly consistent with the national trend (Figure 2–1), with decreasing emissions, except for Prince Edward Island where emissions increased by 3.7 t or 2.2%. According to Table 2–16, the most significant decrease in total emissions between 2013 and 2021 occurred in Quebec (2.6 kt or 34%) followed by Ontario (2.1 kt or 29%) and Alberta (2.0 kt or 26%). Percentage decrease is most noticeable in New Brunswick (64%).

The full-time series of national, provincial, and territorial black carbon emissions from 2013 to 2021 are also available online on the Government of Canada Open Data Portal.[4]

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

Table 2–16 **Black Carbon Emissions from Canadian Provinces and Territories (2013 to 2021)**

Province/Territories	Black Carbon (tonnes)									2013–2021 trend
	2013	2014	2015	2016	2017	2018	2019	2020	2021	
Alberta	7 800	7 500	7 000	6 200	6 800	6 500	6 300	5 600	5 700	-26%
British Columbia	3 900	3 500	3 300	3 100	3 200	3 300	3 100	2 800	2 800	-27%
Manitoba	1 600	1 600	1 400	1 400	1 500	1 500	1 300	1 200	1 100	-30%
New Brunswick	1 400	1 400	1 400	1 000	710	690	580	520	490	-64%
Newfoundland and Labrador	860	850	850	890	840	920	950	780	760	-12%
Nova Scotia	1 300	1 100	1 100	990	980	1 000	970	850	820	-37%
Northwest Territories	520	480	440	380	400	410	370	300	340	-36%
Nunavut	190	160	140	170	260	130	170	90	90	-52%
Ontario	7 200	6 600	6 500	6 200	6 200	6 400	6 100	5 300	5 200	-29%
Prince Edward Island	170	150	140	160	180	200	200	180	170	2.2%
Quebec	7 700	7 200	7 000	6 100	5 900	6 000	5 900	5 200	5 100	-34%
Saskatchewan	4 300	4 700	4 400	3 900	4 000	4 100	3 700	3 600	3 400	-22%
Yukon	110	78	73	65	70	79	76	65	71	-36%
CANADA	**37 000**	**35 000**	**34 000**	**31 000**	**31 000**	**31 000**	**30 000**	**26 000**	**26 000**	**-30%**

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

BLACK CARBON INVENTORY DEVELOPMENT

As mentioned in the introduction, the Black Carbon (BC) Inventory is based on the Air Pollutant Emissions Inventory (APEI) (Environment and Climate Change Canada [ECCC], 2023). This chapter gives an overview of the development of the Black Carbon Inventory. For more details on the APEI development, refer to Chapter 3 of the APEI Report (ECCC, 2023).

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

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

For example, diesel engines have relatively high emission rates of $PM_{2.5}$ per unit energy, and the fraction of black carbon in these $PM_{2.5}$ emissions is also relatively high. The majority of diesel fuel in Canada is used for mobile sources, including off-road applications. Other combustion sources with high $PM_{2.5}$ emissions include solid fuel combustion units, such as coal- and wood-fired boilers and wood fireplaces. Industrial sources are generally equipped with highly effective $PM_{2.5}$ controls on boiler emissions, with PM-control efficiencies often in the 90% range. This is reflected in the lower $PM_{2.5}$ emissions compared to 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. For example, estimates for Agricultural Fuel Combustion sources are based on the fuel type and quantity consumed in Canada and the corresponding $BC/PM_{2.5}$ fraction. A lower $BC/PM_{2.5}$ fraction specific to agricultural fuel consumption is used.

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. For two sources, exceptions to the standard methodology are used to estimate black carbon emissions. In some upstream oil and gas subsectors, black carbon emissions from flaring are directly calculated using the volume of flared gas, the higher heating value (HHV) of the gas, and an empirical equation relating the HHV to black carbon emissions (Quadram Engineering, 2019).

To estimate emissions from mobile sources, bottom-up approaches were adopted, i.e. applying fuel-specific emission factors to disaggregated activity data, such as vehicle or equipment data sorted by class, age or model year. In most cases, $PM_{2.5}$ was estimated first, and $BC/PM_{2.5}$ fractions were subsequently applied. The methods for estimating $PM_{2.5}$ emissions from mobile sources are described in the APEI Report (ECCC, 2023).

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 facilities to the National Pollutant Release Inventory (NPRI). For sources of $PM_{2.5}$ that are not covered by NPRI reporting requirements, their $PM_{2.5}$ emissions are calculated using activity data (i.e., statistics datasets) and emission factors. For this inventory, emissions from Manufacturing, Electric Power Generation as well as Ore and Mineral Industries are estimated using facility data. Oil and Gas Industry estimates are based on facility-reported data used in combination with the results of independent studies (EC, 2014; ECCC, 2017; Quadram, 2019). Emissions due to agricultural, construction and residential (wood and other) fuel combustion are estimated from fuel consumption data and combustion technologies information. Commercial Fuel Combustion is estimated using a combination of facility-reported and other data sources.

NPRI facility-reported data of $PM_{2.5}$ releases from stacks form the basis of black carbon estimates. For each individual stack, the appropriate black carbon speciation factor (or factors) 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 and updates 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 fractions to sector or equipment type is made using engineering knowledge and judgment based on limited available information (such as stack names), with varying degrees of accuracy.

There is considerable uncertainty in determining the proportion of combustion $PM_{2.5}$ emissions from industrial sources. The primary data source for estimating $PM_{2.5}$ emissions from many industrial sources is the NPRI, in which emissions are reported by facilities by stack or as one aggregate value for the facility as a whole and are not broken down between combustion and non-combustion emissions. For some sectors (such as Aluminium, Pulp and Paper, and Cement and Concrete industries), it is assumed that the $PM_{2.5}$ emissions are combustion-related when emissions of both CO and NO_x are reported from the same stack; this assumption contributes to the overall uncertainty.

3.5. Considerations for Future Editions of this Inventory

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

- Explore incorporating emissions from diesel engines used for electricity generation in remote locations that are not currently reporting emissions to the NPRI.
- Review and update the $BC/PM_{2.5}$ fractions for off-road transportation.
- Review and update the BC emission factors for marine transportation.
- Include emissions from prescribed burning, which is the controlled and intentional burning of biomass as a land management practice.
- Explore incorporating emissions from missing industrial sectors, such as Non-Ferrous Refining and Smelting and the Chemicals Industry.

Table 3–1 **Summary of Methodological Changes, Refinement or Improvements**

Description	Impact on Emissions
ORE AND MINERAL INDUSTRIES	
• Recalculations occurred in the Iron and Steel Industry sector for years 2015 to 2020 and the Iron Ore Pelletizing sector in 2020, as a result of revised facility reporting of $PM_{2.5}$ emissions. • Recalculations are present in the Aluminium Industry sector for all past data years, 2013 to 2020, as a result of revised facility reporting of $PM_{2.5}$ emissions and a better understanding of processes in these sectors, allowing for more accurate assignment of speciation factors. • Improved facility allocation to the Foundries sector resulted in upward recalculations for all past data years, 2013 to 2020.	• Recalculations in the Iron and Steel Industry sector were minor and ranged from a maximum decrease of 0.08 tonnes (0.07%) in 2020 to a maximum increase of 0.08 tonnes (0.07%) in 2016. The Iron Ore pelletizing sector also saw a small reduction in 2020 of 0.02 tonnes (0.3%). • The Aluminium sector recalculations were also minor, and ranged from -0.02 tonnes (-0.06%) to +0.88 tonnes (2.8%). • Upward recalculations in the Foundries sector, with a maximum increase of 0.13 tonnes (479%), were large at the sectoral level due to the small number of facilities estimated, but were insignificant on the national total.
OIL AND GAS INDUSTRY	
Recalculations occurred in all years for the Oil Sands In-Situ Extraction sector, as the methodology was updated to use only facility reported $PM_{2.5}$ emissions and no longer includes in-house estimates. Emissions for the Natural Gas Transmission and Storage and Natural Gas Distribution sectors were recalculated due to updated activity data for the period between 2015-2020. Recalculations to Flaring emissions also occurred from 2013-2020 due to updated activity data (reported volumes of flared gas) for Saskatchewan. Further revisions in 2019 and 2020 resulted from updates to facility reported $PM_{2.5}$ emissions.	These recalculations resulted in downward revisions to emissions for the oil and gas sector from 2013 to 2019, ranging from a maximum decrease of 102 tonnes in 2017 to 59 tonnes in 2013. In 2020, recalculations resulted in an increase of 14 tonnes.
ELECTRIC POWER GENERATION (UTILITIES)	
Recalculations occurred in the public electricity and heat production sector in all years back to 2013. Recalculations occurred due to updated subclass codes for a number of facilities reporting to the NPRI.	The recalculations resulted in changes ranging from -5.6 kt in 2014 to 8.0 kt in 2020.
MANUFACTURING	
Recalculations occurred in the Pulp and Paper Industry sector and Wood Products sector for years 2013 to 2016 and 2017 to 2020, as a result of revised facility reporting of $PM_{2.5}$ emissions, revised assignment of speciation factors, and inclusion of missing data from the previous submission.	Recalculations in the Pulp and Paper Industry sector and Wood Products sector ranged from a maximum decrease of 23 tonnes (13%) in 2019 to a maximum increase of 2.8 tonnes (2%) in 2020.
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, 2016, 2017 and 2018 model and produced data for the 2019 and 2020 calendar years. Provincial estimates were redeveloped based on 2015 to 2020 port origin/destination pairs.	The updated MEIT models resulted in significant changes from 2013 to 2020. The change resulted in an apparent decrease of 744 tonnes (47%) for 2013, and an apparent decrease of 323 tonnes (32%) for 2020.
TRANSPORTATION AND MOBILE EQUIPMENT – ON-ROAD	
Recalculations occurred in the on-road transportation sector for all reporting years. These recalculations were most impacted by corrections to diesel fuel oil consumption determined from the RESD in addition to the adoption of the on-road vehicle emissions model, MOVES3. Other updates that significantly impacted on-road transportation estimates, but to a lesser degree include: • Updated method to allocate fuel reported in the RESD between on-road vehicles and off-road vehicles/equipment. • Updates to on-road vehicle population estimates. • Updates to on-road vehicle kilometer accumulation rates. • Updates to off-road vehicle/equipment populations.	Recalculations for the on-road transportation sector were significant for most reporting years, ranging from a decrease of 0.3 kilotonnes (4%) in 2013 to a decrease of 3.3 kilotonnes (53%) in 2020.
TRANSPORTATION AND MOBILE EQUIPMENT – OFF-ROAD	
Recalculations occurred in the off-road transportation sector for all reporting years. These recalculations were most impacted by corrections to diesel fuel oil consumption determined from the RESD in addition to an updated method to allocate fuel reported in the RESD between on-road vehicles and off-road vehicles/equipment. Other updates that significantly impacted off-road transportation estimates, but to a lesser degree include: • Updates to off-road vehicle/equipment populations. • Updates to on-road vehicle population estimates. • Updates to on-road vehicle kilometer accumulation rates. • Updates to emission rates for off-road diesel engines compliant with Tier 4 exhaust standards.	Recalculations for the off-road transportation sector were significant for most reporting years, ranging from a decrease of 1.8 kilotonnes (12%) in 2020 to an increase of 2.1 kilotonnes (15%) in 2016.
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL – HOME FIREWOOD BURNING	
Recalculations occurred in the commercial/institutional and residential sector in all years back to 2013. Recalculations occurred due to updated fuel consumption data in the Report on Energy Supply and Demand in Canada, and the Households and the Environment Survey.	The recalculations resulted in changes ranging from -26 kt in 2020 to 0.002 kt in 2016.

SECTOR DESCRIPTIONS

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

Table A1–1 **Black Carbon Inventory 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[a]	Castings of various types of ferro-alloys as well as small iron and steel foundries not associated with integrated iron and steel facilities. The types of foundries included are open ferrous, electric arc and induction foundries.
Iron and Steel Industry	Steel production, including blast furnaces, basic oxygen furnaces, electric arc furnaces, sintering, direct reduction of iron, hot forming and semi-finishing, and coke production.
Iron Ore Pelletizing	The process includes grinding, drying, balling, and thermal treatment of iron-containing raw materials (i.e., fine iron ore and additives).
Mining and Rock Quarrying	Overburden removal, drilling in rock, blasting, crushing of rock, loading of materials, transporting raw materials by conveyors, scraping, bulldozing, grading, open storage pile losses and wind erosion from exposed areas.
OIL AND GAS INDUSTRY	
Disposal and Waste Treatment	Treatment and disposal of any oilfield or processing waste fluids or produced water. Typically injected into a disposal well.
Flaring	An open flame used for routine or emergency disposal of waste gas.
Heavy Crude Oil Cold Production	Production of heavy crude oil which does not involve the use of any thermal techniques. Heavy crude oil is a category of crude oil characterized by relatively high viscosity, a higher carbon-to-hydrogen ratio, and a density greater than 900 kg/m^3 or more (25° or less American Petroleum Institute [API]). Heavy crude oil typically is more difficult to extract with conventional recovery techniques and is more costly to refine.
Light/Medium Crude Oil Production	Production of light- and medium-density crude oils characterized by relatively low viscosity, a lower carbon-to-hydrogen ratio and a density less than 900 kg/m^3 (greater than 25° API).
Natural Gas Production and Processing	Production of natural gas from natural gas wells, as well as associated gas production from oil wells. Processing of the raw natural gas to remove undesired constituents such as helium, ethane, natural gas liquids (NGLs), water, H_2S and CO_2 to upgrade the quality of the natural gas to meet contract specifications. May also include the fractionation of mixed NGLs to natural gas products and possibly adjusting the heating value by the addition or removal of nitrogen.
Natural Gas Transmission and Storage	Transportation of sales-quality natural gas from the producers to market and storage of natural gas (typically in underground caverns) to accommodate the fluctuating differences between gas supply and demand rates.
Natural Gas Distribution	Local distribution of natural gas from the transmission system to the final end-users.
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/Servicing/Testing	The drilling of wells to produce crude oil and natural gas. Well-related activities performed after drilling consisting of well completions, testing, workovers and abandonments. Sometimes the test may be conducted into a flow or gathering line; however, more often the liquids are produced into temporary tankage brought on site for the test, and the gas phase is either vented or flared. Emissions from diesel engines used to power the rigs are included in the off-road use of diesel.
ELECTRIC POWER GENERATION (UTILITIES)	
Coal	Electric power generation from combustion of coal by utilities (both publicly and privately owned) for commercial sales and/or private use.
Landfill Gas	Electric power generation from combustion of landfill gas by utilities (both publicly and privately) for commercial sales and/or private use.
Natural Gas	Electric power generation from combustion of natural gas by utilities (both publicly and privately owned) for commercial sales and/or private use.
Diesel	Electric power generation from combustion of diesel by utilities (both publicly and privately owned) for commercial sales and/or private use.
Other (Electric Power Generation)	Electric power generation from other energy sources by utilities (both publicly and privately owned) for commercial sales and/or private use.

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

MANUFACTURING	
Pulp and Paper Industry	Chemical, mechanical, recycling and semi-chemical pulp mills, including the production of energy through the combustion of spent pulping liquor, biomass and fossil-fuel combustion. Also includes fugitive emissions from wood refining, screening and drying, and various steps in chemical recovery systems.
Wood Products	Sawmills, panelboard mills (including veneer, plywood, waferboard, particle board and medium-density fiberboard mills), and other wood products manufacturing establishments (including furniture and cabinet makers, wood treating plants, wood pellet mills and Masonite manufacturers).
TRANSPORTATION AND MOBILE EQUIPMENT	
Air Transportation (LTO)	Landing and takeoff (LTO) cycles from piston and turbine aircraft used for commercial and private operations. LTO cycles and cruise modes from piston and turbine aircraft used for military operations.
Domestic Air Transportation (Cruise)	Cruise modes from aircraft used for domestic commercial and private operations.
International Air Transportation (Cruise)	Cruise modes from aircraft used for international commercial and private operations.
Domestic Marine Navigation, Fishing and Military	Marine vessels engaged in domestic navigation, fishing, or military operations within Canadian waters.
International Marine Navigation	Marine vessels engaged in international navigation within Canadian waters.
On-Road Transport – Diesel	Diesel road vehicles, including light- and heavy-duty trucks, and automobiles.
On-Road Transport – Gasoline	Gasoline road vehicles, including light- and heavy-duty trucks, automobiles and motorcycles.
On-Road Transport – Liquid Petroleum Gas	Propane road vehicles, including light- and heavy-duty trucks, automobiles.
On-Road Transport – Natural Gas	Natural gas road vehicles, including light- and heavy-duty trucks, automobiles.
Off-Road Transport – Diesel	Off-road vehicles and mobile equipment using diesel fuel in mining, construction, agriculture, logging, railway maintenance and airport ground support; lawn and garden equipment, such as vehicles and equipment used for commercial purposes; and recreational vehicles.
Off-Road Transport – Gasoline, Liquid Petroleum Gas and Natural Gas	Off-road vehicles and mobile equipment using gasoline, liquid petroleum or compressed natural gas in mining, construction, agriculture, logging, railway maintenance, airport ground support, for commercial purposes, lawn and garden equipment or recreational vehicles.
Rail Transportation	Emissions from freight and passenger trains, including yard-switching activities.
AGRICULTURE	
Agricultural Fuel Combustion	Stationary combustion sources in agricultural facilities such as space and water heating and crop drying.
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	
Commercial and Institutional Fuel Combustion	Combustion of fossil and biogenic fuels used for space/water heating in commercial establishments, health and educational institutions and government/public administration facilities.
Construction Fuel Combustion	Combustion of fossil fuels used for space heating and the heating of construction materials, such as concrete.
Home Firewood Burning	Burning of wood, pellets and manufactured logs as fuel for space heating and hot water. Includes emissions from fireplaces, wood stoves and wood-fired boilers.
Residential Fuel Combustion	Combustion of fossil fuels used for space/water heating in residences.

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

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

Table A2–1	Fractions of Black Carbon to $PM_{2.5}$, Ore and Mineral Industries	23
Table A2–2	Fractions of Black Carbon to $PM_{2.5}$, Oil and Gas Industry	24
Table A2–3	Fractions of Black Carbon to $PM_{2.5}$, Electric Power Generation (Utilities)	25
Table A2–4	Fractions of Black Carbon to $PM_{2.5}$, Manufacturing	25
Table A2–5	Fractions of Black Carbon to $PM_{2.5}$, Transportation and Mobile Equipment	26
Table A2–6	Fractions of Black Carbon to $PM_{2.5}$, Agriculture	26
Table A2–7	Fractions of Black Carbon to $PM_{2.5}$, Commercial/Residential/Institutional	27

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

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)
	Primary Aluminum Smelting and Refining	Aluminium Processing, baghouse (avg)	0.020165	2910110 291012.5 2910130 29101C	Average of 4 speciation factors from U.S. EPA (2014a)
		Aluminium Reduction Potline	0.0268	2910210	U.S. EPA (2014a)
		Average of large stack BC/$PM_{2.5}$ fractions	0.0228378	NA	Weighted average
	Secondary Aluminium Production (Includes Recycling)	Secondary Aluminium – Dross Recovery Furnace	0.014258	2010310 201032.5 2010330 20103C	U.S. EPA (2014a)
Cement and Concrete Industry	Cement Manufacture	Cement Kiln (Coal-Fired)	0.002	2720310	U.S. EPA (2014a)
		Cement Kiln	0.027801	4331	U.S. EPA (2014a)
	Concrete Batching and Products	Sector Specific Speciation Factor – Concrete Batching & Products	0.001704	NA	U.S. EPA (2014a)
	Gypsum Product Manufacturing	Sector Specific Speciation Factor – Gypsum Product Manufacturing	0.01467	NA	U.S. EPA (2014a)
	Lime Manufacturing	Lime Kiln	0.00464	23202C	U.S. EPA (2014a)
Foundries	Die Casting	Cast Iron Cupola – Composite	0.009096	91157	U.S. EPA (2014a)
	Ferrous Foundries	Cast Iron Cupola – Composite	0.009096	91157	U.S. EPA (2014a)
	Non-Ferrous Foundries	Primary Metal Production – Average	0.01002	9000730	U.S. EPA (2014a)
Iron and Steel Industry	Primary (Blast Furnace and DRI)	Iron and Steel facility – Coke Making	0.137466	8945	U.S. EPA (2014a)
		Blast Furnace Charging	0.024	NA	EEA (2019) (2.C.1 Iron and Steel Production, Table 3.9)
	Secondary (Electric Arc Furnace)	Electric Arc Furnace / Basic Oxygen Furnace – Composite	0.00363	283052.5 3989 3997	Average of 3 speciation factors U.S. EPA (2011) Speciate 4.3
		Iron and Steel facility – Hot forming	0.023967	8948	U.S. EPA (2014a)
Iron Ore Industry	Iron Ore Pelletization	Iron and Steel facility – Sintering	0.008653	8946	U.S. EPA (2014a)

Table A2–1 **Fractions of Black Carbon to $PM_{2.5}$, Ore and Mineral Industries** (cont'd)

Sector	Subsector	$BC/PM_{2.5}$ Fractions		Profile	Reference
		Description	Value (w/w)		
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/Servicing	Flaring	0.24	NA	McEwen (2012)
Heavy Crude Oil Cold Production Light/Medium Crude Oil Production Natural Gas Production and Processing Oil Sands In-Situ Extraction Well Testing	Flaring	NA	NA	**Emission Factors**: Quadram (2019) **Activity Data**: AER (2022); BCOGC (2020; 2022); CNLOPB (2022); Petrinex (2022); SKMER (2022)
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/Servicing/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/Servicing/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	Bituminous Coal Combustion – Simplified	0.01696	92104	U.S. EPA (2014a)
Diesel	Diesel Exhaust	0.77124	92106	U.S. EPA (2014a)
Natural Gas	Gas-Fired Combined Cycle and Cogeneration Plants	0.025	5671	U.S. EPA (2014a)
Other (Electric Power Generation)	Diesel Exhaust[a]	0.77124	92106	U.S. EPA (2014a)
	Distillate Oil Combustion	0.1	4736	U.S. EPA (2014a)
	Flare Gas	0.24	NA	McEwen (2012)
	Gas-Fired Combined Cycle and Cogeneration Plants	0.025	5671	U.S. EPA (2014a)
	Landfill Gas	0.384	91112	U.S. EPA (2014a)
	Oil Combustion	0.429969	3864	U.S. EPA (2014a)
	Residual Oil Combustion	0.01	4737	U.S. EPA (2014a)
	Wood Fired Boiler – Simplified	0.037088024	92114	U.S. EPA (2014a)

Notes:
NA = Not applicable
a. This diesel is included as part of other electric power generation since it is the diesel combustion occuring 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	0.06926	NA	Weighted average
	Converted Paper Product Manufacturing	Average of large stack $BC/PM_{2.5}$ fractions	0.06926	NA	Weighted average
Wood Products	Panel Board Mills	Wood-Fired Boiler – Simplified	0.03709	92114	U.S. EPA (2014a)
		Wood Products – Drying – Composite	0.08	91128	U.S. EPA (2014a)
		Composite wood and natural gas boilers	0.21054	91114 91112	U.S. EPA (2014a)
		Average of large stack $BC/PM_{2.5}$ fractions	0.08553	NA	Weighted average
	Sawmills	Wood-Fired Boiler – Simplified	0.03709	92114	U.S. EPA (2014a)
		Wood Products – Drying – Composite	0.08	91128	U.S. EPA (2014a)
	Other (Wood Products)	Wood-Fired Boiler – Simplified	0.03709	92114	U.S. EPA (2014a)
		Wood Products – Drying – Composite	0.08	91128	U.S. EPA (2014a)
		Average of large stack $BC/PM_{2.5}$ fractions	0.05139	NA	Weighted average

Note:
NA = Not applicable

Table A2–5 **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 – without Diesel Particulate Filter	0.7897	8995	U.S. EPA (2019)
	Diesel – with Diesel Particulate Filter	0.09984	8996	U.S. EPA (2019)
	Gasoline	0.12178	91113	U.S. EPA (2019)
	Liquid Petroleum Gas	0.1	NA	Fushimi et al. (2015)
	Natural Gas	0.3699	95219	U.S. EPA (2019)
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)		
Agricultural Fuel Combustion	Coal	0.239526	91155	U.S. EPA (2014a)
	Kerosene & Stove Oil	0.1	91115	U.S. EPA (2014a)
	Light Fuel Oil	0.1	91115	U.S. EPA (2014a)
	Natural Gas	0.067	91156	U.S. EPA (2014a)
	Natural Gas Liquids	0.067	91156	U.S. EPA (2014a)

Table A2–7 **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

SUBMISSION TO THE UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE

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

A3.1. Overview of the United Nations Economic Commission for Europe Reporting Template

Canada is using the United Nations Economic Commission for Europe's (UNECE) Annex I emissions reporting template and the associated Nomenclature for Reporting (NFR) codes for reporting its black carbon emissions internationally. The UNECE NFR categories correspond to the sectors described in the *EMEP/EEA Air Pollutant Emission Inventory Guidebook 2019* (EEA, 2019). In addition to providing technical guidance for developing inventory methodologies, the 2019 EMEP/EEA guidebook includes instructions for attributing sectoral emissions to NFR codes. Whereas the Black Carbon Inventory Report groups emissions by sectors (e.g. pulp and paper industry), the emissions in the UNECE are grouped by process and combustion sources. For example, the pulp and paper industry within the Black Carbon Inventory Report includes both combustion and process emissions. The black carbon emissions are associated with the combustion component which is mapped to NFR sector 1A2d (Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print). The process component is mapped to NFR sector 2H1 (Pulp and paper industry) which does not produce any black carbon emissions. Table A3–1 illustrates the structure of the UNECE reporting template. The template, last revised November 18, 2019, can be found in its entirety on the CEIP website.

A3.2. Mapping of Black Carbon Inventory Emissions to the United Nations Economic Commission for Europe's Nomenclature for Reporting Categories

The mapping of black carbon inventory emissions to UNECE NFR categories is based on the mapping of the $PM_{2.5}$ emissions from the Air Pollutant Inventory Report (ECCC, 2023). As specified in section 3.1 of the present report, only the $PM_{2.5}$ emissions from combustion activities are used to estimate the black carbon emissions. In adherence to the UNECE NFR structure, the majority of sectoral emissions from this inventory are redistributed into their combustion and process components following 2019 EMEP/EEA guidebook.

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

In most cases, to redistribute emissions from the Black Carbon Inventory sectors to the NFR categories, ratios based on sources and pollutants are used to allocate emissions to the appropriate combustion and process NFR codes. In some instances, in-house estimation methodologies are used to produce detailed emissions by source, and emissions are assigned directly to the appropriate NFR code. Table A3–2 provides a summary of Canada's black carbon emissions allocated into the respective NFR code.

Table A3–1 **Excerpt from United Nations Economic Commission for Europe Nomenclature for Reporting Template for 2023**

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

Notes:
BC = black carbon
IIR = Informative Inventory Report, which is equivalent to Air Pollutant Emissions Inventory Report and Black Carbon Report in Canada
GNFR = Gridded nomenclature for reporting
LPS = Large point source
NMVOC = Non-methane volatile organic compounds (refer to Annex 1 for more information)
TSP = Total suspended particles (equivalent to TPM in this report)

A3.3. Reporting International Marine Navigation and Air Transportation Emissions

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

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

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

Table A3–2 **Canadian Black Carbon Emissions by Nomenclature for Reporting Codes for 2023 Submission**

NFR Aggregation	NFR Code	Long name	BC emissions (kt)								
			2013	2014	2015	2016	2017	2018	2019	2020	2021
A_PublicPower	1A1a	Public electricity and heat production	0.21	0.23	0.24	0.24	0.21	0.22	0.21	0.20	0.19
B_Industry	1A1c	Manufacture of solid fuels and other energy industries	1.14	1.23	1.17	1.16	1.21	1.26	1.26	1.20	1.27
B_Industry	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.12	0.13	0.13	0.13	0.13	0.14	0.14	0.11	0.11
B_Industry	1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03
B_Industry	1A2d	Stationary combustion in manufacturing industries and construction: Pulp, paper and print	0.27	0.22	0.20	0.18	0.17	0.16	0.15	0.15	0.14
B_Industry	1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.02
B_Industry	1A2gviii	Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	0.70	0.62	0.62	0.54	0.65	0.54	0.59	0.53	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	0.00	0.00
C_OtherStationaryComb	1A4ai	Commercial/institutional: Stationary	0.83	0.88	0.84	0.89	0.97	1.01	1.07	1.04	1.02
C_OtherStationaryComb	1A4bi	Residential: Stationary	8.18	8.15	7.81	7.33	7.33	7.75	7.57	6.93	6.62
C_OtherStationaryComb	1A4ci	Agriculture/Forestry/Fishing: Stationary	0.06	0.06	0.05	0.05	0.05	0.04	0.05	0.05	0.05
D_Fugitive	1B1a	Fugitive emission from solid fuels: Coal mining and handling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D_Fugitive	1B2c	Venting and flaring (oil, gas, combined oil and gas)	1.47	1.77	1.63	1.23	1.29	1.30	1.23	1.29	1.38
F_RoadTransport	1A3bi	Road transport: Passenger cars	0.16	0.15	0.16	0.16	0.16	0.18	0.19	0.16	0.16
F_RoadTransport	1A3bii	Road transport: Light duty vehicles	0.21	0.21	0.23	0.26	0.29	0.35	0.40	0.36	0.41
F_RoadTransport	1A3biii	Road transport: Heavy duty vehicles and buses	6.96	6.29	5.11	3.90	3.34	3.12	2.74	2.42	2.40
F_RoadTransport	1A3biv	Road transport: Mopeds & motorcycles	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
G_Shipping	1A3dii	National navigation (shipping)	0.71	0.64	0.58	0.60	0.59	0.61	0.67	0.52	0.60
H_Aviation	1A3ai(i)	International aviation LTO (civil)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01
H_Aviation	1A3aii(i)	Domestic aviation LTO (civil)	0.20	0.18	0.18	0.17	0.18	0.20	0.19	0.12	0.14
I_Offroad	1A2gvii	Mobile Combustion in manufacturing industries and construction: (please specify in the IIR)	6.27	5.40	5.81	5.34	5.56	5.31	4.91	3.92	3.75
I_Offroad	1A3c	Railways	1.86	1.73	1.48	1.32	1.41	1.51	1.36	1.21	1.19
I_Offroad	1A3ei	Pipeline Transport	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
I_Offroad	1A3eii	Other (please specify in the IIR)	0.81	0.72	0.76	0.72	0.72	0.67	0.61	0.52	0.50
I_Offroad	1A4aii	Commercial/institutional: Mobile	1.11	0.98	1.11	1.13	1.23	1.28	1.25	1.07	1.11
I_Offroad	1A4bii	Residential: Household and gardening (mobile)	0.12	0.12	0.12	0.13	0.13	0.13	0.13	0.13	0.12
I_Offroad	1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	5.35	5.33	5.29	5.01	5.37	5.25	4.90	4.39	4.11
I_Offroad	1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.10	0.06	0.01	0.01	0.01	0.02	0.02	0.02	0.02
I_Offroad	1A5b	Other, Mobile (including military, land based and recreational boats)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02
TOTAL			**37**	**35**	**34**	**31**	**31**	**31**	**30**	**26**	**26**

Note:
0.00 Indicates emissions were truncated due to rounding.
IIR = Informative Inventory Report, which is equivalent to Air Pollutant Emissions Inventory Report and Black Carbon Report in Canada.

Other Emissions Estimated in the Black Carbon Inventory

NFR Aggregation	NFR Code	Long name	BC emissions (kt)								
			2013	2014	2015	2016	2017	2018	2019	2020	2021
O_AviCruise	1A3ai(ii)	International aviation cruise (civil)	0.37	0.36	0.37	0.38	0.42	0.48	0.49	0.22	0.23
O_AviCruise	1A3aii(ii)	Domestic aviation cruise (civil)	0.23	0.22	0.21	0.21	0.23	0.25	0.25	0.14	0.16
P_IntShipping	1A3di(i)	International maritime navigation	1.25	1.15	1.05	1.05	1.03	1.07	0.90	0.70	0.75

ANNEX 4

PROVINCIAL AND TERRITORIAL BLACK CARBON EMISSIONS ESTIMATES, 2013 to 2021

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

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

Table A4–1 **Black Carbon Emissions Summary for Newfoundland and Labrador (2013 to 2021)**

Source Category and Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
ORE AND MINERAL INDUSTRIES	**58**	**45**	**43**	**44**	**24**	**20**	**31**	**50**	**46**
Aluminium Industry	-	-	-	-	-	-	-	-	-
Cement and Concrete Industry	-	-	-	-	-	-	-	-	-
Foundries[a]	-	-	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-	-	-
Iron Ore Pelletizing	4.0	4.2	4.5	4.6	3.9	3.1	3.6	3.7	3.5
Mining and Rock Quarrying	54	41	39	39	20	17	27	46	43
OIL AND GAS INDUSTRY	**87**	**100**	**85**	**84**	**97**	**120**	**110**	**81**	**62**
Disposal and Waste Treatment	-	-	-	-	-	-	-	-	-
Flaring	71	87	73	72	84	110	95	64	48
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	16	15	12	12	13	13	14	16	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/Servicing/Testing	-	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	**25**	**32**	**36**	**51**	**25**	**25**	**21**	**15**	**17**
Coal	-	-	-	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-	-	-	-
Diesel	24	30	35	50	22	23	19	13	16
Other (Electric Power Generation)	0.86	1.3	1.4	1.6	3.0	1.9	2.2	1.8	0.69
MANUFACTURING	**0.64**	**0.62**	**0.81**	**0.84**	**1.6**	**1.6**	**0.58**	**0.59**	**0.58**
Pulp and Paper Industry	0.64	0.62	0.65	0.64	1.4	1.4	0.33	0.33	0.33
Wood Products	-	-	0.16	0.20	0.20	0.23	0.25	0.26	0.25
TRANSPORTATION AND MOBILE EQUIPMENT	**510**	**510**	**530**	**510**	**440**	**440**	**460**	**330**	**350**
Air Transportation (LTO)	12	11	11	12	11	11	11	7.9	8.1
Domestic Marine Navigation, Fishing and Military	160	130	99	100	110	110	150	130	150
On-Road Transport	87	95	73	65	49	50	49	38	34
Diesel	81	88	66	58	40	41	40	29	24
Gasoline	5.5	6.4	7.0	7.4	8.5	8.6	9.1	9.1	10
Liquid Petroleum Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	-	-	-	-	-	-	-	-	-
Off-Road Transport	240	270	340	330	270	260	240	140	140
Diesel	230	250	320	310	260	250	230	130	130
Gasoline, Liquid Petroleum Gas and Natural Gas	13	13	13	13	13	11	10	8.8	8.6
Rail Transportation	13	10	9.1	8.3	8.9	8.7	10	9.0	8.9
AGRICULTURE	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Fuel Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	**170**	**160**	**150**	**200**	**250**	**310**	**320**	**310**	**280**
Commercial and Institutional Fuel Combustion	2.6	2.9	3.0	2.8	2.5	1.9	2.0	1.6	1.3
Construction Fuel Combustion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Home Firewood Burning	170	160	150	190	240	310	320	300	280
Fireplaces	10	8.5	7.0	8.1	8.6	11	11	10	9.3
Furnaces	130	120	110	150	190	230	230	210	200
Wood Stoves	33	31	29	38	49	72	85	81	75
Residential Fuel Combustion	0.28	0.34	0.29	0.31	0.39	0.38	0.36	0.31	0.23
TOTAL	**860**	**850**	**850**	**890**	**840**	**920**	**950**	**780**	**760**

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

Other Emissions Estimated in the Black Carbon Inventory

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Domestic Air Transportation (Cruise)	6.8	6.5	6.2	6.1	6.2	6.3	6.9	3.5	4.0
International Air Transportation (Cruise)	8.8	8.1	7.7	6.8	6.7	6.9	6.3	4.1	4.8
International Marine Navigation	75	67	58	53	49	41	37	42	45

Table A4–2 **Black Carbon Emissions Summary for Prince Edward Island (2013 to 2021)**

Source Category and Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
ORE AND MINERAL INDUSTRIES	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Aluminium Industry	-	-	-	-	-	-	-	-	-
Cement and Concrete Industry	-	-	-	-	-	-	-	-	-
Foundries[a]	-	-	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	-	-	-	-	-	-	-	-	-
OIL AND GAS INDUSTRY	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Disposal and Waste Treatment	-	-	-	-	-	-	-	-	-
Flaring	-	-	-	-	-	-	-	-	-
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	-	-	-	-	-	-	-	-	-
Natural Gas Production and Processing	-	-	-	-	-	-	-	-	-
Natural Gas Transmission and Storage	-	-	-	-	-	-	-	-	-
Natural Gas Distribution	-	-	-	-	-	-	-	-	-
Oil Sands In-Situ Extraction	-	-	-	-	-	-	-	-	-
Oil Sands Mining, Extraction and Upgrading	-	-	-	-	-	-	-	-	-
Petroleum Liquids Storage	-	-	-	-	-	-	-	-	-
Petroleum Liquids Transportation	-	-	-	-	-	-	-	-	-
Well Drilling/Servicing/Testing	-	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Coal	-	-	-	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-	-	-	-
Diesel	-	-	-	-	0.00	0.00	0.00	0.00	0.00
Other (Electric Power Generation)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MANUFACTURING	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Pulp and Paper Industry	-	-	-	-	-	-	-	-	-
Wood Products	-	-	-	-	-	-	-	-	-
TRANSPORTATION AND MOBILE EQUIPMENT	**78**	**80**	**87**	**84**	**77**	**77**	**70**	**57**	**54**
Air Transportation (LTO)	0.54	0.47	0.45	0.48	0.49	0.47	0.48	0.20	0.14
Domestic Marine Navigation, Fishing and Military	13	12	12	12	14	14	13	4.0	5.3
On-Road Transport	32	35	32	26	18	19	16	13	12
Diesel	30	33	31	24	17	17	14	12	10
Gasoline	1.7	1.6	1.7	1.9	1.9	1.7	2.0	1.8	2.0
Liquid Petroleum Gas	-	-	-	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-	-	-	-
Off-Road Transport	33	32	42	46	45	43	41	40	36
Diesel	30	29	39	42	41	41	38	38	34
Gasoline, Liquid Petroleum Gas and Natural Gas	3.2	3.0	3.1	3.3	3.5	2.4	2.3	2.2	1.9
Rail Transportation	-	-	-	-	-	-	-	-	-
AGRICULTURE	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Fuel Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	**88**	**67**	**49**	**75**	**100**	**120**	**130**	**120**	**120**
Commercial and Institutional Fuel Combustion	0.38	0.27	0.26	0.13	0.14	0.16	0.19	0.20	0.21
Construction Fuel Combustion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Home Firewood Burning	87	67	49	74	100	120	130	120	120
Fireplaces	3.8	2.4	1.3	1.3	0.80	1.2	2.7	2.5	2.4
Furnaces	73	56	41	64	86	100	120	110	100
Wood Stoves	11	8.3	6.2	9.5	13	15	15	14	13
Residential Fuel Combustion	0.27	0.22	0.18	0.18	0.19	0.18	0.19	0.18	0.16
TOTAL	**170**	**150**	**140**	**160**	**180**	**200**	**200**	**180**	**170**

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

Other Emissions Estimated in the Black Carbon Inventory

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Domestic Air Transportation (Cruise)	0.48	0.52	0.57	0.57	0.73	0.64	0.91	0.20	0.30
International Air Transportation (Cruise)	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.00	0.00
International Marine Navigation	2.2	2.0	1.9	2.1	1.4	1.2	1.2	2.1	2.3

Table A4–3 **Black Carbon Emissions Summary for Nova Scotia (2013 to 2021)**

Source Category and Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
ORE AND MINERAL INDUSTRIES	**1.6**	**0.26**	**0.41**	**0.53**	**0.92**	**2.7**	**1.5**	**11**	**1.8**
Aluminium Industry	-	-	-	-	-	-	-	-	-
Cement and Concrete Industry	0.49	-	0.41	0.53	0.27	2.0	1.4	1.5	1.6
Foundries[a]	-	-	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	1.1	0.26	-	-	0.65	0.62	0.15	9.5	0.24
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/Servicing/Testing	-	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	**6.0**	**5.9**	**6.5**	**4.2**	**4.6**	**5.0**	**5.8**	**6.2**	**6.2**
Coal	4.7	3.8	5.0	2.9	3.2	2.9	3.6	3.2	2.5
Natural Gas	0.15	0.24	0.40	0.24	0.14	0.20	0.57	0.65	0.92
Diesel	-	-	-	-	-	-	-	-	-
Other (Electric Power Generation)	1.1	1.9	1.1	1.0	1.3	1.9	1.6	2.3	2.8
MANUFACTURING	**23**	**23**	**15**	**4.3**	**2.7**	**4.3**	**4.3**	**4.3**	**4.3**
Pulp and Paper Industry	20	21	12	1.7	0.00	1.8	1.3	0.10	0.10
Wood Products	3.5	2.8	2.7	2.7	2.7	2.6	3.0	4.3	4.3
TRANSPORTATION AND MOBILE EQUIPMENT	**550**	**420**	**370**	**330**	**370**	**360**	**390**	**310**	**310**
Air Transportation (LTO)	5.5	5.0	4.9	5.5	5.6	5.9	5.7	3.0	2.9
Domestic Marine Navigation, Fishing and Military	100	84	63	60	81	87	150	110	130
On-Road Transport	130	130	110	83	74	72	62	59	60
Diesel	130	120	100	73	65	60	49	47	46
Gasoline	7.3	7.0	9.1	9.8	9.0	12	12	12	14
Liquid Petroleum Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Off-Road Transport	290	200	180	170	200	190	160	130	120
Diesel	280	190	160	160	180	170	140	120	110
Gasoline, Liquid Petroleum Gas and Natural Gas	17	14	17	17	17	17	17	14	12
Rail Transportation	9.8	8.8	8.0	8.1	8.5	8.0	5.9	4.6	4.5
AGRICULTURE	**0.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Fuel Use	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	**690**	**650**	**720**	**630**	**590**	**620**	**560**	**520**	**490**
Commercial and Institutional Fuel Combustion	8.1	7.9	9.3	10	13	13	13	13	13
Construction Fuel Combustion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Home Firewood Burning	680	640	700	620	580	600	550	500	480
Fireplaces	52	49	53	47	43	39	31	28	27
Furnaces	490	470	520	460	430	440	400	370	350
Wood Stoves	130	120	130	120	110	120	120	110	100
Residential Fuel Combustion	1.3	1.2	1.2	0.98	1.0	1.2	1.2	1.1	1.0
TOTAL	**1 300**	**1 100**	**1 100**	**990**	**980**	**1 000**	**970**	**850**	**820**

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

Other Emissions Estimated in the Black Carbon Inventory

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Domestic Air Transportation (Cruise)	6.8	6.6	6.9	6.7	7.4	8.0	8.1	3.3	3.6
International Air Transportation (Cruise)	4.1	3.8	4.1	4.2	4.0	4.5	4.6	3.2	4.3
International Marine Navigation	140	120	100	110	120	130	82	80	88

Table A4–4 **Black Carbon Emissions Summary for New Brunswick (2013 to 2021)**

Source Category and Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
ORE AND MINERAL INDUSTRIES	**1.2**	**1.3**	**0.28**	**0.00**	**0.00**	**0.00**	**1.2**	**0.36**	**0.62**
Aluminium Industry	-	-	-	-	-	-	-	-	-
Cement and Concrete Industry	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Foundries[a]	-	-	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	1.1	1.2	0.28	0.00	0.00	0.00	1.2	0.35	0.62
OIL AND GAS INDUSTRY	**0.10**	**0.10**	**0.00**	**0.10**	**0.00**	**0.10**	**0.00**	**0.00**	**0.00**
Disposal and Waste Treatment	-	-	-	-	-	-	-	-	-
Flaring	0.10	0.10	0.00	0.10	0.00	0.10	0.00	0.00	0.00
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	-	-	-	-	-	-	-	-	-
Natural Gas Production and Processing	-	-	-	-	-	-	-	-	-
Natural Gas Transmission and Storage	-	-	-	-	-	-	-	-	-
Natural Gas Distribution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oil Sands In-Situ Extraction	-	-	-	-	-	-	-	-	-
Oil Sands Mining, Extraction and Upgrading	-	-	-	-	-	-	-	-	-
Petroleum Liquids Storage	-	-	-	-	-	-	-	-	-
Petroleum Liquids Transportation	-	-	-	-	-	-	-	-	-
Well Drilling/Servicing/Testing	-	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	**2.2**	**1.0**	**1.6**	**1.7**	**0.64**	**2.0**	**0.21**	**0.26**	**0.82**
Coal	0.22	0.11	0.68	0.90	0.28	1.8	0.00	0.10	0.45
Natural Gas	2.0	0.87	0.82	0.78	0.34	0.15	0.15	0.13	0.33
Diesel	-	-	-	-	-	-	-	-	-
Other (Electric Power Generation)	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00
MANUFACTURING	**29**	**28**	**35**	**24**	**23**	**19**	**23**	**22**	**16**
Pulp and Paper Industry	8.8	12	11	8.5	7.5	6.2	6.8	11	5.7
Wood Products	21	16	23	16	15	13	16	11	11
TRANSPORTATION AND MOBILE EQUIPMENT	**420**	**360**	**310**	**290**	**250**	**230**	**200**	**170**	**170**
Air Transportation (LTO)	4.9	4.3	4.5	4.3	4.3	4.7	4.6	2.8	2.1
Domestic Marine Navigation, Fishing and Military	37	28	20	24	27	23	23	15	19
On-Road Transport	120	120	91	99	68	60	53	50	46
Diesel	110	110	84	89	60	52	44	41	37
Gasoline	7.0	5.8	7.3	9.2	8.1	8.0	9.2	8.1	8.5
Liquid Petroleum Gas	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	-	-	-	-	-	-	-	-	-
Off-Road Transport	220	180	170	140	120	120	96	83	83
Diesel	200	170	150	120	110	100	83	70	72
Gasoline, Liquid Petroleum Gas and Natural Gas	21	15	17	18	16	14	13	12	11
Rail Transportation	30	27	26	24	26	24	22	18	17
AGRICULTURE	**0.40**	**0.51**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Fuel Use	0.40	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	**930**	**980**	**1 000**	**690**	**440**	**440**	**360**	**330**	**310**
Commercial and Institutional Fuel Combustion	5.6	6.2	6.2	5.7	5.2	5.7	6.0	5.6	5.4
Construction Fuel Combustion	0.00	0.00	0.10	0.00	0.10	0.00	0.00	0.00	0.00
Home Firewood Burning	920	980	1 000	680	430	430	350	320	300
Fireplaces	85	76	65	32	12	7.1	6.3	5.8	5.4
Furnaces	630	670	720	490	320	310	240	220	210
Wood Stoves	210	220	240	160	100	110	100	93	87
Residential Fuel Combustion	0.66	0.91	1.1	0.68	0.59	0.58	0.53	0.47	0.41
TOTAL	**1 400**	**1 400**	**1 400**	**1 000**	**710**	**690**	**580**	**520**	**490**

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

Other Emissions Estimated in the Black Carbon Inventory

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Domestic Air Transportation (Cruise)	3.3	3.2	3.2	3.1	3.1	3.4	3.5	1.6	1.7
International Air Transportation (Cruise)	0.57	0.68	0.75	0.48	0.46	0.78	0.83	0.43	0.38
International Marine Navigation	43	37	30	31	31	29	22	20	21

Table A4–5 **Black Carbon Emissions Summary for Quebec (2013 to 2021)**

Source Category and Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
ORE AND MINERAL INDUSTRIES	**98**	**92**	**80**	**74**	**83**	**96**	**95**	**86**	**110**
Aluminium Industry	45	41	34	34	33	29	26	29	32
Cement and Concrete Industry	1.4	2.7	4.6	0.86	1.5	5.0	2.0	1.8	7.1
Foundries[a]	0.11	0.16	0.13	0.10	0.13	0.10	0.10	0.10	0.15
Iron and Steel Industry	2.6	6.8	4.3	3.3	4.5	9.9	9.6	7.9	9.3
Iron Ore Pelletizing	2.3	2.3	2.6	2.7	2.4	2.7	2.9	1.8	1.6
Mining and Rock Quarrying	47	39	35	33	42	49	54	45	62
OIL AND GAS INDUSTRY	**2.2**	**2.1**	**2.2**	**2.3**	**2.4**	**2.4**	**2.4**	**2.1**	**2.2**
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	0.17	0.17	0.17	0.17	0.17	0.17
Natural Gas Distribution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oil Sands In-Situ Extraction	-	-	-	-	-	-	-	-	-
Oil Sands Mining, Extraction and Upgrading	-	-	-	-	-	-	-	-	-
Petroleum Liquids Storage	-	-	-	-	-	-	-	-	-
Petroleum Liquids Transportation	2.0	1.9	2.0	2.1	2.2	2.1	2.2	1.9	2.0
Well Drilling/Servicing/Testing	-	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	**43**	**46**	**47**	**45**	**44**	**46**	**46**	**46**	**44**
Coal	-	-	-	-	-	-	-	-	-
Natural Gas	0.10	0.10	0.10	0.10	0.00	0.00	0.00	0.00	-
Diesel	22	23	24	24	24	25	24	25	25
Other (Electric Power Generation)	21	23	23	21	20	21	21	21	19
MANUFACTURING	**120**	**100**	**95**	**78**	**65**	**64**	**67**	**49**	**54**
Pulp and Paper Industry	82	63	54	48	48	47	41	29	28
Wood Products	36	41	41	30	16	17	26	20	26
TRANSPORTATION AND MOBILE EQUIPMENT	**3 900**	**3 400**	**3 200**	**2 700**	**2 700**	**2 500**	**2 400**	**2 000**	**2 000**
Air Transportation (LTO)	32	30	29	28	30	33	32	21	24
Domestic Marine Navigation, Fishing and Military	240	230	210	200	190	190	130	89	99
On-Road Transport	1 200	1 100	990	770	680	590	510	450	450
Diesel	1 100	1 000	930	710	610	510	420	360	340
Gasoline	65	59	63	64	68	77	89	89	100
Liquid Petroleum Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Off-Road Transport	2 300	1 900	1 900	1 600	1 700	1 600	1 600	1 300	1 300
Diesel	2 200	1 800	1 800	1 500	1 600	1 500	1 500	1 200	1 300
Gasoline, Liquid Petroleum Gas and Natural Gas	120	100	97	93	100	100	100	97	92
Rail Transportation	110	100	85	78	81	100	97	90	89
AGRICULTURE	**1.1**	**1.1**	**1.1**	**1.2**	**1.0**	**1.0**	**1.1**	**0.90**	**0.88**
Fuel Use	1.1	1.1	1.1	1.2	1.0	1.0	1.1	0.90	0.88
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	**3 500**	**3 600**	**3 600**	**3 300**	**3 000**	**3 300**	**3 300**	**3 000**	**2 800**
Commercial and Institutional Fuel Combustion	110	120	120	130	130	120	120	110	110
Construction Fuel Combustion	13	13	12	13	13	15	15	14	14
Home Firewood Burning	3 400	3 500	3 400	3 100	2 900	3 100	3 200	2 900	2 700
Fireplaces	390	400	390	350	330	470	570	520	490
Furnaces	1 800	1 900	1 900	1 700	1 600	1 600	1 400	1 300	1 200
Wood Stoves	1 200	1 200	1 100	1 000	930	1 100	1 200	1 100	1 000
Residential Fuel Combustion	6.3	6.3	6.2	6.5	6.4	6.7	7.2	6.3	6.4
TOTAL	**7 700**	**7 200**	**7 000**	**6 100**	**5 900**	**6 000**	**5 900**	**5 200**	**5 100**

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

Other Emissions Estimated in the Black Carbon Inventory

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Domestic Air Transportation (Cruise)	23	21	21	21	23	26	27	18	21
International Air Transportation (Cruise)	61	59	60	62	67	79	88	39	41
International Marine Navigation	400	380	350	340	300	290	210	230	250

Table A4–6 **Black Carbon Emissions Summary for Ontario (2013 to 2021)**

Source Category and Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
ORE AND MINERAL INDUSTRIES	**190**	**190**	**180**	**160**	**170**	**170**	**170**	**150**	**140**
Aluminium Industry	-	-	-	-	-	-	-	-	-
Cement and Concrete Industry	9.2	8.8	9.8	11	11	10	11	6.6	7.6
Foundries[a]	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron and Steel Industry	110	120	120	120	120	130	120	99	94
Iron Ore Pelletizing	-	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	63	63	52	35	37	36	34	41	37
OIL AND GAS INDUSTRY	**16**	**15**	**16**	**13**	**14**	**15**	**15**	**14**	**14**
Disposal and Waste Treatment	-	-	-	-	-	-	-	-	-
Flaring	7.3	6.1	6.3	4.3	4.7	5.6	5.4	4.5	4.5
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas Production and Processing	1.8	1.5	1.6	1.0	1.1	1.2	1.2	1.0	0.97
Natural Gas Transmission and Storage	6.0	7.1	7.1	7.1	7.2	7.3	7.5	7.4	7.6
Natural Gas Distribution	0.15	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17
Oil Sands In-Situ Extraction	-	-	-	-	-	-	-	-	-
Oil Sands Mining, Extraction and Upgrading	-	-	-	-	-	-	-	-	-
Petroleum Liquids Storage	0.54	0.43	0.41	0.41	0.44	0.83	0.83	0.68	0.82
Petroleum Liquids Transportation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Well Drilling/Servicing/Testing	-	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	**22**	**22**	**20**	**23**	**15**	**18**	**17**	**17**	**17**
Coal	2.3	0.10	-	-	-	-	-	-	-
Natural Gas	6.0	5.5	5.0	4.5	3.5	3.5	3.5	3.0	2.9
Diesel	13	16	12	12	11	13	14	14	14
Other (Electric Power Generation)	0.32	1.2	2.5	6.5	1.2	1.2	0.23	0.33	0.32
MANUFACTURING	**79**	**75**	**81**	**75**	**76**	**67**	**78**	**83**	**80**
Pulp and Paper Industry	35	31	30	29	31	27	27	29	27
Wood Products	44	43	52	46	45	41	51	53	53
TRANSPORTATION AND MOBILE EQUIPMENT	**4 700**	**4 000**	**4 200**	**3 900**	**3 900**	**3 800**	**3 400**	**2 800**	**2 800**
Air Transportation (LTO)	57	50	51	52	53	58	55	32	36
Domestic Marine Navigation, Fishing and Military	48	39	31	34	28	27	17	15	16
On-Road Transport	1 900	1 700	1 300	1 100	920	880	830	720	750
Diesel	1 800	1 500	1 200	890	740	660	570	500	520
Gasoline	130	140	150	160	180	220	260	210	230
Liquid Petroleum Gas	0.10	0.00	0.00	0.10	0.10	0.10	0.10	0.12	0.16
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Off-Road Transport	2 100	1 700	2 300	2 400	2 500	2 500	2 200	1 800	1 700
Diesel	1 900	1 500	2 100	2 200	2 300	2 300	2 000	1 600	1 500
Gasoline, Liquid Petroleum Gas and Natural Gas	230	200	200	200	180	180	180	160	180
Rail Transportation	520	510	430	360	390	370	320	280	270
AGRICULTURE	**8.5**	**6.5**	**5.4**	**5.4**	**4.8**	**5.0**	**5.5**	**5.3**	**5.8**
Fuel Use	8.5	6.5	5.4	5.4	4.8	5.0	5.5	5.3	5.8
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	**2 200**	**2 300**	**2 100**	**2 000**	**2 100**	**2 300**	**2 400**	**2 200**	**2 100**
Commercial and Institutional Fuel Combustion	360	400	380	390	410	440	480	490	480
Construction Fuel Combustion	10	9.8	9.4	9.7	8.8	9.0	9.8	9.4	11
Home Firewood Burning	1 800	1 800	1 600	1 500	1 600	1 800	1 800	1 600	1 600
Fireplaces	260	250	220	210	210	200	170	150	150
Furnaces	1 200	1 200	1 100	1 000	1 100	1 200	1 300	1 200	1 100
Wood Stoves	360	360	320	310	310	350	360	320	310
Residential Fuel Combustion	77	77	78	71	73	78	73	66	64
TOTAL	**7 200**	**6 600**	**6 500**	**6 200**	**6 200**	**6 400**	**6 100**	**5 300**	**5 200**

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

Other Emissions Estimated in the Black Carbon Inventory

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Domestic Air Transportation (Cruise)	69	65	67	69	73	79	81	40	46
International Air Transportation (Cruise)	160	150	160	170	190	220	230	100	120
International Marine Navigation	54	50	51	55	39	36	23	27	28

Table A4–7 **Black Carbon Emissions Summary for Manitoba (2013 to 2021)**

Source Category and Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
ORE AND MINERAL INDUSTRIES	**0.24**	**0.23**	**0.25**	**0.23**	**0.54**	**0.51**	**0.50**	**0.39**	**0.40**
Aluminium Industry	-	-	-	-	-	-	-	-	-
Cement and Concrete Industry	0.20	0.18	0.21	0.19	0.21	0.21	0.19	0.20	0.20
Foundries[a]	-	-	-	-	-	-	-	-	-
Iron and Steel Industry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron Ore Pelletizing	-	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	-	0.00	0.00	0.00	0.29	0.27	0.27	0.16	0.16
OIL AND GAS INDUSTRY	**32**	**31**	**29**	**27**	**25**	**29**	**31**	**24**	**23**
Disposal and Waste Treatment	-	-	-	-	-	-	-	-	-
Flaring	31	30	28	26	24	26	27	23	22
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	0.39	0.38	0.35	0.33	0.30	0.33	0.34	0.29	0.28
Natural Gas Production and Processing	-	-	-	-	-	-	-	-	-
Natural Gas Transmission and Storage	0.13	0.26	0.42	0.26	0.16	0.41	0.44	0.16	0.16
Natural Gas Distribution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oil Sands In-Situ Extraction	-	-	-	-	-	-	-	-	-
Oil Sands Mining, Extraction and Upgrading	-	-	-	-	-	-	-	-	-
Petroleum Liquids Storage	0.00	0.12	0.00	0.00	0.93	3.0	3.0	0.36	0.49
Petroleum Liquids Transportation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Well Drilling/Servicing/Testing	-	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	**2.7**	**2.8**	**3.0**	**2.8**	**2.7**	**2.8**	**2.7**	**2.9**	**2.8**
Coal	-	-	-	-	-	-	-	-	-
Natural Gas	0.17	0.15	0.23	0.10	0.10	0.00	0.00	0.00	0.00
Diesel	2.5	2.6	2.8	2.7	2.7	2.7	2.6	2.9	2.8
Other (Electric Power Generation)	-	-	-	-	-	-	-	-	-
MANUFACTURING	**14**	**12**	**10**	**15**	**14**	**15**	**14**	**14**	**11**
Pulp and Paper Industry	14	11	10	15	14	14	11	12	8.3
Wood Products	0.72	0.64	0.39	0.60	0.68	0.88	2.2	2.7	2.6
TRANSPORTATION AND MOBILE EQUIPMENT	**1 300**	**1 300**	**1 100**	**1 100**	**1 100**	**1 100**	**1 000**	**950**	**860**
Air Transportation (LTO)	17	15	15	15	16	17	17	14	17
Domestic Marine Navigation, Fishing and Military	1.4	0.80	0.18	0.00	0.19	0.58	0.17	0.10	0.10
On-Road Transport	260	250	200	170	160	160	150	130	130
Diesel	230	220	180	150	140	130	120	100	98
Gasoline	26	24	24	24	23	29	33	30	34
Liquid Petroleum Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	-	-	-	-	-	-	-	-	-
Off-Road Transport	830	860	760	810	850	830	750	710	620
Diesel	770	800	700	750	790	780	700	670	570
Gasoline, Liquid Petroleum Gas and Natural Gas	66	61	61	56	54	55	52	46	47
Rail Transportation	160	150	130	110	120	130	110	93	92
AGRICULTURE	**0.11**	**0.10**	**0.10**	**0.10**	**0.10**	**0.12**	**0.12**	**0.12**	**0.11**
Fuel Use	0.11	0.10	0.10	0.10	0.10	0.12	0.12	0.12	0.11
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	**270**	**270**	**240**	**250**	**280**	**290**	**250**	**230**	**220**
Commercial and Institutional Fuel Combustion	43	46	41	40	43	47	49	44	42
Construction Fuel Combustion	5.2	4.7	4.5	5.0	4.3	4.8	4.8	4.6	4.7
Home Firewood Burning	220	220	190	200	230	230	190	180	170
Fireplaces	7.0	6.8	5.8	6.1	6.9	11	15	14	13
Furnaces	200	200	180	190	220	180	100	95	89
Wood Stoves	8.4	7.7	6.1	6.0	6.1	40	75	69	65
Residential Fuel Combustion	5.0	5.0	4.2	4.4	4.6	4.9	4.9	4.7	4.4
TOTAL	**1 600**	**1 600**	**1 400**	**1 400**	**1 500**	**1 500**	**1 300**	**1 200**	**1 100**

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

Other Emissions Estimated in the Black Carbon Inventory

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Domestic Air Transportation (Cruise)	13	13	12	12	13	14	14	8.7	10
International Air Transportation (Cruise)	3.3	3.1	3.1	3.2	3.2	3.3	3.5	2.2	1.5
International Marine Navigation	2.0	1.8	1.7	0.00	0.10	0.11	0.54	0.28	0.29

Table A4–8 **Black Carbon Emissions Summary for Saskatchewan (2013 to 2021)**

Source Category and Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
ORE AND MINERAL INDUSTRIES	**24**	**17**	**15**	**17**	**13**	**17**	**17**	**18**	**19**
Aluminium Industry	-	-	-	-	-	-	-	-	-
Cement and Concrete Industry	-	-	-	0.00	0.00	-	-	-	-
Foundries[a]	-	-	-	-	-	-	-	-	-
Iron and Steel Industry	0.10	0.20	0.11	0.10	0.17	0.14	0.12	0.14	0.15
Iron Ore Pelletizing	-	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	24	17	15	17	13	17	17	18	19
OIL AND GAS INDUSTRY	**840**	**1 000**	**970**	**740**	**720**	**710**	**650**	**630**	**640**
Disposal and Waste Treatment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Flaring	800	980	930	700	690	670	610	600	610
Heavy Crude Oil Cold Production	10	10	11	9.2	9.2	8.9	8.5	6.6	8.4
Light/Medium Crude Oil Production	5.7	3.4	3.7	3.8	3.6	3.9	3.3	2.8	1.7
Natural Gas Production and Processing	15	15	15	15	15	15	15	13	12
Natural Gas Transmission and Storage	7.2	6.3	6.3	6.3	6.3	6.3	6.3	6.4	6.4
Natural Gas Distribution	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Oil Sands In-Situ Extraction	1.3	0.95	0.88	0.96	0.60	1.4	1.6	0.97	0.52
Oil Sands Mining, Extraction and Upgrading	4.6	2.3	3.6	2.3	2.1	1.9	3.2	3.5	2.8
Petroleum Liquids Storage	-	-	-	-	-	-	-	-	-
Petroleum Liquids Transportation	-	-	-	-	-	-	-	-	-
Well Drilling/Servicing/Testing	-	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	**5.3**	**5.2**	**6.1**	**5.9**	**6.1**	**13**	**9.9**	**9.5**	**11**
Coal	3.7	3.7	3.8	3.7	3.6	11	8.6	7.9	9.7
Natural Gas	1.6	1.5	1.8	1.8	2.1	2.1	0.94	1.2	1.2
Diesel	-	-	0.45	0.36	0.39	0.39	0.38	0.37	0.33
Other (Electric Power Generation)	-	-	-	-	-	0.00	0.00	0.00	0.00
MANUFACTURING	**28**	**3.4**	**4.3**	**4.4**	**4.4**	**4.7**	**4.5**	**4.6**	**4.7**
Pulp and Paper Industry	0.32	0.29	0.13	0.00	0.00	0.17	0.00	0.00	-
Wood Products	27	3.1	4.2	4.3	4.4	4.5	4.5	4.6	4.7
TRANSPORTATION AND MOBILE EQUIPMENT	**3 300**	**3 500**	**3 300**	**3 000**	**3 100**	**3 100**	**2 900**	**2 700**	**2 500**
Air Transportation (LTO)	13	12	11	10	9.8	10	9.6	6.6	8.3
Domestic Marine Navigation, Fishing and Military	-	-	-	-	-	-	-	-	-
On-Road Transport	840	750	690	470	430	430	390	380	380
Diesel	790	710	630	420	370	370	330	320	320
Gasoline	49	45	52	56	57	59	59	53	55
Liquid Petroleum Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Off-Road Transport	2 200	2 500	2 400	2 300	2 400	2 500	2 300	2 200	2 000
Diesel	2 100	2 400	2 300	2 200	2 300	2 400	2 200	2 100	1 900
Gasoline, Liquid Petroleum Gas and Natural Gas	110	99	110	110	100	98	96	84	84
Rail Transportation	240	220	190	170	190	210	190	160	160
AGRICULTURE	**0.56**	**0.63**	**0.73**	**0.56**	**0.70**	**0.70**	**0.53**	**0.55**	**0.57**
Fuel Use	0.56	0.63	0.73	0.56	0.70	0.70	0.53	0.55	0.57
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	**140**	**130**	**120**	**140**	**160**	**180**	**190**	**170**	**170**
Commercial and Institutional Fuel Combustion	36	37	36	44	48	53	55	50	49
Construction Fuel Combustion	1.3	1.5	1.8	1.3	1.7	1.7	1.3	1.3	1.4
Home Firewood Burning	89	85	71	84	110	120	120	120	110
Fireplaces	4.8	5.3	5.0	6.5	9.2	7.3	4.6	4.3	4.1
Furnaces	80	76	63	74	94	110	110	100	100
Wood Stoves	4.2	3.9	3.1	3.5	4.3	6.5	8.1	7.6	7.3
Residential Fuel Combustion	10	9.8	8.4	7.9	7.7	8.5	8.9	8.0	7.9
TOTAL	**4 300**	**4 700**	**4 400**	**3 900**	**4 000**	**4 100**	**3 700**	**3 600**	**3 400**

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

Other Emissions Estimated in the Black Carbon Inventory

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Domestic Air Transportation (Cruise)	6.0	6.0	5.9	5.5	5.7	6.1	5.9	2.8	3.8
International Air Transportation (Cruise)	2.5	2.4	2.1	2.0	1.8	1.7	1.5	0.71	0.47
International Marine Navigation	-	-	-	-	-	-	-	-	-

Table A4–9 **Black Carbon Emissions Summary for Alberta (2013 to 2021)**

Source Category and Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
ORE AND MINERAL INDUSTRIES	**3.2**	**3.4**	**3.2**	**1.3**	**1.5**	**1.0**	**1.3**	**1.6**	**0.30**
Aluminium Industry	-	-	-	-	-	-	-	-	-
Cement and Concrete Industry	1.1	1.5	2.8	1.0	1.2	0.82	0.69	0.76	0.27
Foundries[a]	-	-	-	-	-	-	-	-	-
Iron and Steel Industry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron Ore Pelletizing	-	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	2.1	1.8	0.38	0.24	0.22	0.22	0.59	0.85	0.00
OIL AND GAS INDUSTRY	**1 400**	**1 600**	**1 500**	**1 400**	**1 500**	**1 500**	**1 500**	**1 600**	**1 800**
Disposal and Waste Treatment	0.10	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.00
Flaring	460	530	480	340	400	400	420	530	610
Heavy Crude Oil Cold Production	84	86	88	86	88	92	91	83	82
Light/Medium Crude Oil Production	130	130	130	130	130	140	140	120	120
Natural Gas Production and Processing	410	420	420	410	420	420	430	400	400
Natural Gas Transmission and Storage	12	13	13	14	14	14	14	14	14
Natural Gas Distribution	0.46	0.37	0.32	0.32	0.34	0.33	0.31	0.10	0.15
Oil Sands In-Situ Extraction	140	120	120	130	130	170	180	170	180
Oil Sands Mining, Extraction and Upgrading	200	310	250	250	290	280	270	280	330
Petroleum Liquids Storage	2.9	2.5	2.6	2.2	0.99	1.0	2.8	2.3	6.3
Petroleum Liquids Transportation	1.1	1.2	1.3	1.4	1.4	1.5	1.5	1.5	1.6
Well Drilling/Servicing/Testing	3.0	2.9	1.3	0.89	1.4	1.4	1.1	0.62	1.0
ELECTRIC POWER GENERATION (UTILITIES)	**35**	**42**	**38**	**38**	**39**	**27**	**24**	**21**	**13**
Coal	26	34	30	29	30	21	18	14	7.2
Natural Gas	2.0	2.0	2.0	2.0	2.2	2.3	1.9	2.2	2.4
Diesel	4.8	4.9	5.1	5.2	6.0	2.3	2.7	3.6	2.4
Other (Electric Power Generation)	1.4	1.3	1.3	1.2	1.2	1.2	1.3	1.2	1.2
MANUFACTURING	**84**	**50**	**76**	**35**	**24**	**25**	**27**	**33**	**32**
Pulp and Paper Industry	32	16	18	22	11	12	9.9	9.6	10
Wood Products	53	34	58	13	14	13	17	23	22
TRANSPORTATION AND MOBILE EQUIPMENT	**5 800**	**5 400**	**5 000**	**4 200**	**4 500**	**4 200**	**4 100**	**3 400**	**3 400**
Air Transportation (LTO)	33	31	29	26	27	30	29	17	19
Domestic Marine Navigation, Fishing and Military	0.00	0.00	-	-	0.10	-	-	-	-
On-Road Transport	1 800	1 700	1 300	950	840	860	800	690	680
Diesel	1 700	1 700	1 200	880	760	770	700	600	590
Gasoline	71	71	71	72	76	89	100	84	89
Liquid Petroleum Gas	0.15	0.14	0.16	0.12	0.15	0.15	0.16	0.18	0.20
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Off-Road Transport	3 700	3 400	3 400	3 100	3 400	3 100	3 100	2 500	2 500
Diesel	3 400	3 200	3 300	2 800	3 200	2 900	2 900	2 400	2 400
Gasoline, Liquid Petroleum Gas and Natural Gas	230	210	180	210	190	180	180	150	170
Rail Transportation	290	270	230	210	230	240	210	190	190
AGRICULTURE	**34**	**35**	**33**	**32**	**31**	**25**	**23**	**18**	**15**
Fuel Use	34	35	33	32	31	25	23	18	15
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	**380**	**370**	**320**	**520**	**760**	**660**	**520**	**500**	**480**
Commercial and Institutional Fuel Combustion	180	190	170	190	230	250	250	240	230
Construction Fuel Combustion	9.7	9.8	10	11	12	13	14	13	14
Home Firewood Burning	160	140	110	280	490	360	220	210	200
Fireplaces	12	9.7	7.0	17	28	34	30	29	28
Furnaces	130	120	91	240	420	290	160	160	150
Wood Stoves	10	9.4	7.4	20	37	36	28	27	26
Residential Fuel Combustion	40	38	35	35	35	37	36	36	34
TOTAL	**7 800**	**7 500**	**7 000**	**6 200**	**6 800**	**6 500**	**6 300**	**5 600**	**5 700**

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

Other Emissions Estimated in the Black Carbon Inventory

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Domestic Air Transportation (Cruise)	46	46	44	43	44	48	47	25	30
International Air Transportation (Cruise)	36	36	36	34	35	38	38	15	14
International Marine Navigation	0.00	0.00	-	-	0.00	-	-	-	-

Table A4–10 **Black Carbon Emissions Summary for British Columbia (2013 to 2021)**

Source Category and Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
ORE AND MINERAL INDUSTRIES	**31**	**26**	**14**	**12**	**23**	**23**	**27**	**32**	**32**
Aluminium Industry	5.4	3.5	2.1	1.1	1.2	1.1	3.6	3.9	1.2
Cement and Concrete Industry	1.8	1.6	1.4	1.4	2.3	2.0	2.1	2.1	2.3
Foundries[a]	-	-	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	24	21	11	9.3	20	20	21	26	29
OIL AND GAS INDUSTRY	**200**	**220**	**200**	**180**	**190**	**180**	**160**	**170**	**180**
Disposal and Waste Treatment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Flaring	85	110	92	73	81	78	66	71	86
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	5.7	5.8	5.0	5.0	5.0	4.9	4.6	4.7	4.5
Natural Gas Production and Processing	100	100	94	93	95	93	84	88	88
Natural Gas Transmission and Storage	7.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Natural Gas Distribution	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Oil Sands In-Situ Extraction	-	-	-	-	-	-	-	-	-
Oil Sands Mining, Extraction and Upgrading	-	-	-	-	-	-	-	-	-
Petroleum Liquids Storage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Petroleum Liquids Transportation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Well Drilling/Servicing/Testing	-	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	**10**	**8.9**	**8.3**	**9.1**	**9.2**	**10**	**12**	**10**	**10**
Coal	-	-	-	-	-	-	-	-	-
Natural Gas	0.30	0.13	0.12	0.10	0.10	0.14	0.17	0.12	0.12
Diesel	9.6	8.7	8.0	8.5	8.8	9.3	11	9.2	9.5
Other (Electric Power Generation)	0.10	0.10	0.22	0.52	0.35	0.73	0.72	0.63	0.80
MANUFACTURING	**120**	**96**	**92**	**89**	**83**	**79**	**75**	**84**	**90**
Pulp and Paper Industry	78	67	64	60	54	52	51	58	63
Wood Products	40	29	28	28	29	27	24	25	27
TRANSPORTATION AND MOBILE EQUIPMENT	**2 900**	**2 600**	**2 600**	**2 400**	**2 400**	**2 500**	**2 200**	**1 900**	**1 900**
Air Transportation (LTO)	42	41	42	40	43	47	45	27	30
Domestic Marine Navigation, Fishing and Military	200	180	160	180	160	170	190	170	200
On-Road Transport	820	730	600	550	480	470	420	390	400
Diesel	780	690	560	510	430	420	370	340	350
Gasoline	44	42	43	47	55	54	53	49	53
Liquid Petroleum Gas	0.23	0.16	0.13	0.10	0.10	0.14	0.16	0.12	0.14
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Off-Road Transport	1 400	1 200	1 400	1 300	1 300	1 400	1 200	960	890
Diesel	1 300	1 100	1 300	1 200	1 200	1 300	1 100	860	790
Gasoline, Liquid Petroleum Gas and Natural Gas	79	73	75	91	96	97	98	99	99
Rail Transportation	490	430	370	340	360	410	390	370	360
AGRICULTURE	**1.5**	**1.5**	**1.6**	**2.3**	**2.3**	**2.5**	**2.4**	**2.4**	**2.1**
Fuel Use	1.5	1.5	1.6	2.3	2.3	2.5	2.4	2.4	2.1
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	**570**	**510**	**420**	**470**	**580**	**580**	**620**	**610**	**620**
Commercial and Institutional Fuel Combustion	81	79	72	81	85	80	86	88	92
Construction Fuel Combustion	2.7	2.6	2.8	3.9	3.9	4.2	4.0	4.0	3.6
Home Firewood Burning	470	410	330	370	470	480	510	500	510
Fireplaces	80	65	47	47	51	52	57	56	57
Furnaces	310	280	230	260	330	310	300	290	300
Wood Stoves	80	72	59	68	89	120	150	150	150
Residential Fuel Combustion	17	16	15	16	17	16	17	17	17
TOTAL	**3 900**	**3 500**	**3 300**	**3 100**	**3 200**	**3 300**	**3 100**	**2 800**	**2 800**

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

Other Emissions Estimated in the Black Carbon Inventory

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Domestic Air Transportation (Cruise)	40	37	37	39	42	48	47	26	32
International Air Transportation (Cruise)	96	92	95	95	110	130	120	56	53
International Marine Navigation	520	480	430	440	480	530	510	280	310

Table A4–11 **Black Carbon Emissions Summary for Yukon (2013 to 2021)**

Source Category and Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
ORE AND MINERAL INDUSTRIES	**-**	**-**	**-**	**2.8**	**2.4**	**1.7**	**0.33**	**0.37**	**1.5**
Aluminium Industry	-	-	-	-	-	-	-	-	-
Cement and Concrete Industry	-	-	-	-	-	-	-	-	-
Foundries[a]	-	-	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	-	-	-	2.8	2.4	1.7	0.33	0.37	1.5
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/Servicing/Testing	-	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	**-**	**-**	**0.69**	**0.74**	**1.8**	**14**	**17**	**14**	**12**
Coal	-	-	-	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-	-	-	-
Diesel	-	-	0.69	0.74	1.8	14	17	14	12
Other (Electric Power Generation)	-	-	-	-	-	-	-	-	-
MANUFACTURING	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Pulp and Paper Industry	-	-	-	-	-	-	-	-	-
Wood Products	-	-	-	-	-	-	-	-	-
TRANSPORTATION AND MOBILE EQUIPMENT	**88**	**62**	**62**	**51**	**56**	**61**	**57**	**42**	**50**
Air Transportation (LTO)	1.8	1.5	1.4	1.2	1.6	2.0	2.0	0.81	1.1
Domestic Marine Navigation, Fishing and Military	0.57	0.55	0.53	0.23	0.10	0.10	0.43	0.37	0.36
On-Road Transport	26	22	22	18	16	14	14	10	9.5
Diesel	25	21	21	17	15	12	11	8.1	7.7
Gasoline	1.1	1.1	1.2	1.3	1.4	1.8	2.2	2.0	1.8
Liquid Petroleum Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	-
Natural Gas	-	-	-	-	-	-	-	-	-
Off-Road Transport	60	38	38	32	39	45	41	31	39
Diesel	58	37	37	30	38	44	39	30	38
Gasoline, Liquid Petroleum Gas and Natural Gas	1.8	1.4	0.89	1.4	0.93	1.2	2.1	1.0	0.94
Rail Transportation	-	-	-	-	-	-	-	-	-
AGRICULTURE	**-**	**-**	**-**	**-**	**-**	**0.00**	**-**	**-**	**-**
Fuel Use	-	-	-	-	-	0.00	-	-	-
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	**23**	**16**	**11**	**11**	**9.0**	**1.5**	**1.5**	**8.1**	**8.1**
Commercial and Institutional Fuel Combustion	0.30	0.17	0.17	0.15	0.14	0.19	0.20	0.19	0.19
Construction Fuel Combustion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Home Firewood Burning	23	15	10	10	8.8	1.3	1.3	7.9	7.9
Fireplaces	-	-	-	-	-	-	-	-	-
Furnaces	23	15	10	10	8.8	1.3	1.3	7.9	7.9
Wood Stoves	-	-	-	-	-	-	-	-	-
Residential Fuel Combustion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	**110**	**78**	**73**	**65**	**70**	**79**	**76**	**65**	**71**

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

Other Emissions Estimated in the Black Carbon Inventory

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Domestic Air Transportation (Cruise)	1.3	1.1	0.99	0.95	1.0	1.2	1.2	0.61	0.75
International Air Transportation (Cruise)	0.17	0.17	0.20	0.18	0.22	0.18	0.16	0.00	0.00
International Marine Navigation	0.23	0.16	0.11	0.63	0.21	0.00	0.10	0.10	0.10

Table A4–12 **Black Carbon Emissions Summary for Northwest Territories (2013 to 2021)**

Source Category and Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
ORE AND MINERAL INDUSTRIES	**240**	**240**	**220**	**200**	**220**	**230**	**200**	**150**	**200**
Aluminium Industry	-	-	-	-	-	-	-	-	-
Cement and Concrete Industry	-	-	-	-	-	-	-	-	-
Foundries[a]	-	-	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	240	240	220	200	220	230	200	150	200
OIL AND GAS INDUSTRY	**3.4**	**3.2**	**2.7**	**2.5**	**0.15**	**0.45**	**2.1**	**1.5**	**1.6**
Disposal and Waste Treatment	-	-	-	-	-	-	-	-	-
Flaring	0.29	0.29	0.21	0.21	0.00	0.00	0.16	0.12	0.12
Heavy Crude Oil Cold Production	-	-	-	-	-	-	-	-	-
Light/Medium Crude Oil Production	1.1	1.1	0.97	0.89	0.00	0.16	0.73	0.52	0.54
Natural Gas Production and Processing	1.3	1.1	0.83	0.79	0.10	0.14	0.69	0.49	0.55
Natural Gas Transmission and Storage	-	-	-	-	-	-	-	-	-
Natural Gas Distribution	-	-	-	-	-	-	-	-	-
Oil Sands In-Situ Extraction	-	-	-	-	-	-	-	-	-
Oil Sands Mining, Extraction and Upgrading	-	-	-	-	-	-	-	-	-
Petroleum Liquids Storage	-	-	-	-	-	-	-	-	-
Petroleum Liquids Transportation	0.75	0.74	0.67	0.61	0.00	0.11	0.50	0.36	0.37
Well Drilling/Servicing/Testing	-	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	**28**	**33**	**42**	**28**	**27**	**28**	**25**	**23**	**22**
Coal	-	-	-	-	-	-	-	-	-
Natural Gas	0.18	0.12	0.10	0.10	0.10	0.13	0.12	0.10	0.10
Diesel	28	33	42	28	27	28	25	23	22
Other (Electric Power Generation)	-	-	-	-	-	-	-	-	-
MANUFACTURING	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Pulp and Paper Industry	-	-	-	-	-	-	-	-	-
Wood Products	-	-	-	-	-	-	-	-	-
TRANSPORTATION AND MOBILE EQUIPMENT	**230**	**190**	**160**	**130**	**130**	**130**	**120**	**100**	**89**
Air Transportation (LTO)	9.4	8.1	8.2	7.5	7.4	8.3	7.9	6.1	7.4
Domestic Marine Navigation, Fishing and Military	3.2	2.2	1.3	1.0	0.96	0.70	1.0	1.3	1.4
On-Road Transport	66	64	59	53	58	52	44	29	23
Diesel	65	63	58	52	57	50	42	28	22
Gasoline	1.3	1.1	1.2	1.2	1.3	1.3	1.6	1.4	1.4
Liquid Petroleum Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
Natural Gas	-	-	-	-	-	-	-	-	-
Off-Road Transport	150	110	94	72	68	73	67	67	57
Diesel	150	110	94	71	67	72	65	66	55
Gasoline, Liquid Petroleum Gas and Natural Gas	0.75	0.62	0.64	1.2	1.2	1.2	1.6	1.4	1.5
Rail Transportation	0.16	0.15	0.14	0.10	0.10	0.10	0.00	0.10	0.10
AGRICULTURE	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Fuel Use	-	-	-	-	-	-	-	-	-
COMMERCIAL/RESIDENTIAL/INSTITUTIONAL	**16**	**16**	**16**	**18**	**22**	**22**	**25**	**23**	**23**
Commercial and Institutional Fuel Combustion	5.2	5.1	5.1	0.29	0.35	0.41	0.47	0.48	0.49
Construction Fuel Combustion	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00
Home Firewood Burning	10	10	11	18	22	21	24	23	23
Fireplaces	-	-	-	-	-	-	-	-	-
Furnaces	10	10	11	18	22	21	24	23	23
Wood Stoves	-	-	-	-	-	-	-	-	-
Residential Fuel Combustion	0.12	0.13	0.11	0.10	0.10	0.10	0.10	0.10	0.10
TOTAL	**520**	**480**	**440**	**380**	**400**	**410**	**370**	**300**	**340**

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

Other Emissions Estimated in the Black Carbon Inventory

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Domestic Air Transportation (Cruise)	5.0	4.4	3.9	3.3	3.3	3.8	3.6	2.2	2.5
International Air Transportation (Cruise)	0.10	0.10	0.10	0.00	0.10	0.10	0.14	0.00	0.00
International Marine Navigation	0.30	0.28	0.27	0.34	0.19	0.00	0.10	0.11	0.11

Table A4–13 **Black Carbon Emissions Summary for Nunavut (2013 to 2021)**

Source Category and Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
ORE AND MINERAL INDUSTRIES	**2.9**	**5.5**	**13**	**28**	**130**	**16**	**68**	**16**	**18**
Aluminium Industry	-	-	-	-	-	-	-	-	-
Cement and Concrete Industry	-	-	-	-	-	-	-	-	-
Foundries[a]	-	-	-	-	-	-	-	-	-
Iron and Steel Industry	-	-	-	-	-	-	-	-	-
Iron Ore Pelletizing	-	-	-	-	-	-	-	-	-
Mining and Rock Quarrying	2.9	5.5	13	28	130	16	68	16	18
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/Servicing/Testing	-	-	-	-	-	-	-	-	-
ELECTRIC POWER GENERATION (UTILITIES)	**29**	**29**	**29**	**30**	**30**	**31**	**31**	**31**	**31**
Coal	-	-	-	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-	-	-	-
Diesel	29	29	29	30	30	31	31	31	31
Other (Electric Power Generation)	-	-	-	-	-	-	-	-	-
MANUFACTURING	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Pulp and Paper Industry	-	-	-	-	-	-	-	-	-
Wood Products	-	-	-	-	-	-	-	-	-
TRANSPORTATION AND MOBILE EQUIPMENT	**160**	**120**	**93**	**110**	**100**	**79**	**74**	**43**	**41**
Air Transportation (LTO)	6.8	5.8	5.6	5.1	5.6	6.4	6.2	4.5	5.1
Domestic Marine Navigation, Fishing and Military	18	16	14	19	17	16	22	9.2	9.5
On-Road Transport	5.6	5.1	4.4	5.1	4.3	3.5	3.1	2.1	1.3
Diesel	5.3	4.8	4.1	4.8	4.0	3.1	2.7	1.7	0.92
Gasoline	0.31	0.27	0.27	0.33	0.34	0.33	0.37	0.37	0.42
Liquid Petroleum Gas	-	-	-	-	-	-	-	-	-
Natural Gas	-	-	-	-	-	-	-	-	-
Off-Road Transport	130	95	69	84	73	53	43	27	25
Diesel	120	93	68	82	71	52	42	26	24
Gasoline, Liquid Petroleum Gas and Natural Gas	1.7	1.5	1.4	1.7	1.6	1.4	1.4	1.2	1.4
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	**190**	**160**	**140**	**170**	**260**	**130**	**170**	**90**	**90**

Notes:
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a. Foundries is being considered for omission from future inventories. If you have any questions, please contact us at apei-iepa@ec.gc.ca or 1-877-877-8375.
0.00 Indicates emissions were truncated due to rounding.
- Indicates no emissions

Other Emissions Estimated in the Black Carbon Inventory

Sector	Black Carbon (tonnes)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Domestic Air Transportation (Cruise)	6.2	6.0	5.5	4.6	5.5	6.2	5.7	4.2	5.0
International Air Transportation (Cruise)	0.56	0.44	0.42	0.37	0.35	0.54	0.30	0.11	0.28
International Marine Navigation	7.5	8.4	11	18	14	16	12	8.4	8.6

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