

National Report by Canada 2017

Enhanced Black Carbon and Methane Emissions
Reductions – Arctic Council Framework for Action

Canada's Biennial National Report on Black Carbon and Methane - 2017

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List of Acronyms, Abbreviations and Units

| | |
|------------------------|--|
| ACAP | Arctic Contaminants Action Program (Arctic Council Working Group) |
| AGGP | Agricultural Greenhouse Gases Program |
| AMAIS | Arctic Marine Activities Integration and Synthesis; also called the Arctic Corridors Project |
| AMAP | Arctic Monitoring and Assessment Programme (Arctic Council Working Group) |
| CCAC | Climate and Clean Air Coalition |
| CCME | Canadian Council of Ministers of the Environment |
| CEC | Commission for Environmental Cooperation |
| CHARS | Canadian High Arctic Research Station |
| CLRTAP | Convention on Long-Range Transboundary Air Pollution |
| CO ₂ | Carbon dioxide |
| ECCC | Environment and Climate Change Canada |
| EGBCM | Expert Group on Black Carbon and Methane |
| EG-SLCP | Expert Group on SLCPs (under ACAP) |
| EIP | Energy Innovation Program |
| GaSP | Gas Seepage Project |
| GHG | Greenhouse gas |
| GMI | Global Methane Initiative |
| IMO | International Maritime Organization |
| IPCC | Intergovernmental Panel on Climate Change |
| kt | Kilotonne |
| LULUCF | Land Use, Land-use Change and Forestry |
| NAPS | National Air Pollution Surveillance Program |
| Pan-Canadian Framework | Canada's Pan-Canadian Framework on Clean Growth and Climate Change |
| PM _{2.5} | Particulate matter up to 2.5 micrometres in size |
| POLAR | Polar Knowledge Canada |
| SDTC | Sustainable Development Technology Canada |
| SLCP | Short-lived climate pollutant |
| SLCPEG | SLCP Expert Group (under AMAP) |
| SLCP Strategy | Environment and Climate Change Canada's Strategy on Short-Lived Climate Pollutants |
| UN | United Nations |
| UNECE | United Nations Economic Commission for Europe |
| UNFCCC | United Nations Framework Convention on Climate Change |
| VOCS | Volatile Organic Compounds |
| WHO | World Health Organization |

Introduction

Canada is pleased to submit the 2017 edition of its biennial National Report on Black Carbon and Methane to the Arctic Council Secretariat. Black carbon and methane are short-lived climate pollutants (SLCPs) – gases and particles that, despite relatively short atmospheric lifetimes, have a potent warming impact on climate and contribute to poor air quality. Canada recognizes the importance of ongoing action to address SLCPs, as part of Canada’s comprehensive approach to addressing climate change and air pollution.

Under the *Arctic Council Framework for Enhanced Action on Black Carbon and Methane Emissions Reductions*, all Arctic States agreed to develop biennial national reports that summarize their emissions of black carbon and methane, as well as emission reduction actions, highlights of best practices and lessons learned, and projects relevant to the Arctic. The objective of these reports is to strengthen actions and mitigation strategies among Arctic States over time, by learning from each other’s policy experiences.

Canadians are experiencing the effects of climate change across the country, particularly in the climate-sensitive North. At the same time, exposure to air pollution is negatively affecting the health of Canadians and degrading the environment. Canada is taking action on climate change through the [Pan-Canadian Framework on Clean Growth and Climate Change](#) (Pan-Canadian Framework). This Framework is Canada’s plan to grow the economy while reducing emissions and building resilience to adapt to a changing climate. To complement the Pan-Canadian Framework, and to help guide Canada’s actions in reducing SLCPs, Environment and Climate Change Canada (ECCC) released in 2017 a [Strategy on Short-lived Climate Pollutants](#). The SLCP Strategy outlines a holistic approach to reducing air pollution and mitigating climate change by addressing SLCPs through enhanced mitigation, science, communications, coordination and international engagement activities.

Work under the Arctic Council, including implementation of the Arctic Council Framework for Enhanced Action on Black Carbon and Methane Emissions Reductions and the production of this biennial Black Carbon and Methane Report, are important components of Canada’s international engagement and collaboration work under the SLCP Strategy. Canada is also proud to have committed, alongside other Arctic States, Permanent Participants and non-Arctic Observer countries, to further reduce black carbon emissions by at least 25 to 33 percent below 2013 levels by 2025 in accordance with the landmark collective goal adopted by Arctic Ministers in the Fairbanks Declaration in May 2017.

Chapter 1: Black Carbon Emissions

Black carbon is a short-lived, small aerosol particle linked to both climate warming and adverse health effects. It is a component of fine particulate matter (PM_{2.5}) generated by the incomplete combustion of fossil fuels and biomass. Black carbon influences climate in multiple ways: by directly heating surrounding air when suspended in the atmosphere; by reducing the reflectivity of the earth's surface when deposited, an effect particularly strong over snow and ice; and through additional indirect effects related to interaction with clouds. Atmospheric black carbon is estimated to be the third largest driver of climate change over the industrial era, after CO₂ and methane. Due to the enhanced warming it causes over ice and snow covered land, black carbon is of particular interest in the polar regions. As a component of PM_{2.5}, black carbon is associated with a broad range of human health impacts, including respiratory and cardiovascular effects.

Diesel emissions, which are very high in black carbon, are of particular concern from a human health perspective. In 2012, the World Health Organization (WHO) classified diesel exhaust as carcinogenic to humans. This conclusion is supported by Health Canada's Diesel Exhaust Health Risk Assessment (2016), which links exposure to diesel exhaust from mobile sources alone to 700 premature deaths in Canada annually. Health Canada's risk assessment found that diesel emissions are associated with significant numbers of acute respiratory symptom days, restricted activity days, asthma symptom days, hospital admissions, emergency room visits, child acute bronchitis episodes and adult chronic bronchitis cases across Canada.

In 2017, Canada released its third annual inventory of black carbon emissions, covering the years 2013 to 2015, and submitted the Inventory to the United Nations Economic Commission for Europe (UNECE). Ongoing yearly production of the black carbon inventory will establish a time series that can be used for trend analysis. The 2017 edition of Canada's Black Carbon Inventory can be found [here](#). Canada's black carbon inventory is also available on the Government of Canada's [Open Data Portal website](#).

The sources included in the third annual black carbon inventory are estimated to account for at least 90% of anthropogenic black carbon emissions, excluding natural sources of black carbon, such as wildfires. Work will continue to improve the completeness and accuracy of the inventory, quantifying the anthropogenic emissions that are not yet included, and refining base data and estimation techniques. In 2015, approximately 38 kilotonnes (kt) of black carbon were emitted in Canada from anthropogenic sources. Transportation and mobile equipment were the highest emitting source of black carbon in Canada, accounting for 57% of total estimated emissions in 2015 (Table 1).

In 2017, Canada committed, alongside Arctic States, Permanent Participants and non-Arctic Observer countries, to reduce black carbon emissions by at least 25 to 33 percent below 2013 levels by 2025 in accordance with the landmark collective goal adopted by Arctic Ministers in the Fairbanks Declaration. Canada is doing its part to achieve the collective goal. According to the most recent inventory, Canada emitted 42 kt of black carbon in 2013. Current projections (Table 2) indicate that Canada will emit about 31 kt of black carbon in 2025, or 26% below 2013 levels. The complete list of measures affecting black carbon emissions used in the projections is included with Table 2. These projections are based on the 2014 data, and do not include emissions impacts from recently introduced measures. Inclusion of

mitigation impacts from recent regulations, as well as 2015 historical data is expected to lower the projected black carbon emissions further.

Transportation and Mobile Equipment

Transportation and mobile equipment includes air, marine, on-road, off-road, and rail transportation. These sources accounted for approximately 57% (21.9 kt) of Canada's estimated black carbon emissions. An important emissions source in this category is on-road and off-road mobile diesel engines, accounting for 43% of estimated total emissions for 2015.

Commercial/Residential/Institutional

This category includes black carbon emissions from home firewood burning, and fuel combustion in commercial and institutional buildings, construction sites, and in homes. It constitutes the second most important source of estimated black carbon emissions in Canada. Within this category, home firewood burning accounts for the largest proportion of estimated emissions, and contributes 11.5 kt or 30% of estimated total black carbon emissions.

Oil and Gas Industry

Oil and gas industry sources include activities in the upstream petroleum industry and account for almost 7% of all black carbon emitted in 2015. Light medium crude oil production, and natural gas production and processing account for the majority of these emissions, each contributing approximately 2% of estimated black carbon emissions.

Ore and Mineral Industries

Black carbon emissions from ore and mineral industries account for about 1% of total black carbon emissions. Mining and rock quarrying accounts for the bulk of black carbon emissions among ore and mineral industries due to the common use of diesel to generate electricity at remote mines.

Electric Power Generation (Utilities)

Electric power generation sources, including the combustion of coal, natural gas and other fuels for the purpose of generating electricity, accounts for less than 1% of Canada's estimated black carbon emissions. Black carbon emissions from electric power generation in Canada are mitigated through measures in place to control emissions of fine particulate matter (PM_{2.5}). However, emissions of black carbon remain regionally significant in Canada's North, where stationary diesel engines are commonly used for electricity generation in remote communities.

Other

Other sectors of the Canadian economy are estimated to be relatively small sources of black carbon emissions. For example, manufacturing accounts for approximately 1% of overall black carbon emissions in Canada, with approximately equal contributions from the pulp and paper and wood product industries.

Table 1: Canadian Black Carbon Emissions by Sector (2015), as reported in Canada's third annual Black Carbon Inventory, published in 2017.

| Sector | Black Carbon (kt) | Percentage of total |
|--|--------------------------|----------------------------|
| Ore and Mineral Industries | 0.45 | 1 |
| Aluminium Industry | 0.04 | < 1 |
| Cement and Concrete Industry | 0.02 | < 1 |
| Foundries | 0.00 | < 1 |
| Mining and Rock Quarrying | 0.39 | 1 |
| Oil and Gas Industry | 2.56 | 7 |
| Upstream Petroleum Industry | 2.56 | 7 |
| Bitumen and Heavy Oil Upgrading | 0.53 | 1 |
| Disposal and Waste Treatment | 0.01 | < 1 |
| Heavy Crude Oil Cold Production | 0.11 | < 1 |
| Light Medium Crude Oil Production | 0.79 | 2 |
| Natural Gas Production and Processing | 0.75 | 2 |
| Oil Sands In-Situ Extraction and Processing | 0.24 | 1 |
| Oil Sands Mining Extraction and Processing | 0.07 | < 1 |
| Petroleum Liquids Storage | 0.00 | < 1 |
| Petroleum Liquids Transportation | 0.00 | < 1 |
| Well Drilling/Service/Testing | 0.05 | < 1 |
| Electric Power Generation (Utilities) | 0.24 | 1 |
| Coal | 0.05 | < 1 |
| Natural Gas | 0.03 | < 1 |
| Diesel | 0.13 | < 1 |
| Other Electric Power Generation | 0.04 | < 1 |
| Manufacturing | 0.43 | 1 |
| Pulp and Paper Industry | 0.21 | 1 |
| Wood Products | 0.22 | 1 |
| Transportation and Mobile Equipment | 21.93 | 57 |
| Air Transportation | 0.67 | 2 |
| Marine Transportation | 1.24 | 3 |
| On-Road Transport | 6.40 | 17 |
| Diesel | 5.68 | 15 |
| Gasoline | 0.72 | 2 |
| Liquid Petroleum Gas | 0.00 | < 1 |
| Compressed Natural Gas | 0.00 | < 1 |
| Off-Road Transport | 11.37 | 30 |
| Diesel | 10.83 | 28 |
| Gasoline, Liquid Petroleum Gas, Compressed Natural Gas | 0.54 | 1 |
| Rail Transportation | 2.25 | 6 |
| Agriculture | 0.02 | < 1 |
| Fuel Use | 0.02 | < 1 |
| Commercial / Residential / Institutional | 12.61 | 33 |
| Commercial and Institutional Fuel Combustion | 0.89 | 2 |
| Construction Fuel Combustion | 0.04 | < 1 |

| | | |
|---|--------------|---------------|
| Home Firewood Burning | 11.52 | 30 |
| Fireplaces | 3.32 | 9 |
| Furnaces | 4.13 | 11 |
| Wood Stoves | 4.08 | 11 |
| Residential Fuel Combustion | 0.16 | < 1 |
| Total black carbon emissions (anthropogenic) | 38.24 | 100 |

Figure 1: Canadian Black Carbon Emissions by Sector (2015), as reported in Canada’s third annual Black Carbon Inventory, published in 2017.

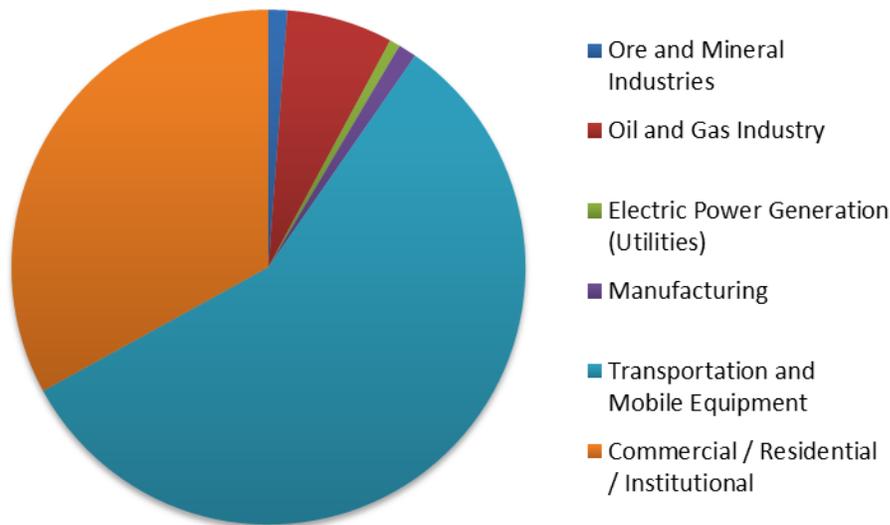


Table 2: Black Carbon Projections to 2030.

Federal and territorial measures included in these projections include (1) On-Road Vehicle and Engine Emission Regulations, Tier 2 and 3 Emission Standards; (2) Off-Road Compression-Ignition Engine Emission Regulations; (3) Off-Road Small Spark-Ignition Engine Emission Regulations; (4) Quebec Clean Air Regulations; (5) Pollution Prevention notice for Base Metals Smelters and Refineries and Zinc Plants (Other Nonferrous; Quebec and New Brunswick); (6) Alberta Air Emission Standards for Electricity Generation; (7) Provincial Commitments for Other Nonferrous sector (Ontario); (8) Base-level Industrial Emissions Requirements for Other Nonferrous sector (British Columbia); and (9) Regulations for Iron Ore Mining Sector (Newfoundland).

| | Total Estimated Emissions of Black Carbon (kt) | % reduction from 2013 |
|-------------|--|-----------------------|
| 2013 | 42.11 | 0 |
| 2014 | 40.98 | 3 |
| 2015 | 38.26 | 9 |
| 2016 | 39.47 | 6 |
| 2017 | 38.38 | 9 |
| 2018 | 37.23 | 12 |

| | | |
|----------------------------|--------------|-----------|
| 2019 | 36.07 | 14 |
| 2020 | 34.91 | 17 |
| 2021 | 33.92 | 19 |
| 2022 | 33.16 | 21 |
| 2023 | 32.42 | 23 |
| 2024 | 31.68 | 25 |
| 2025 | 30.95 | 26 |
| 2026 | 30.52 | 28 |
| 2027 | 30.11 | 28 |
| 2028 | 29.68 | 28 |
| 2029 | 29.28 | 30 |
| 2030 | 28.91 | 31 |
| Inventory values in green | | |
| Projected values in purple | | |

Chapter 2: Methane Emissions

Methane is a greenhouse gas (GHG) estimated to be 25 times more potent a warming agent than CO₂ over a 100-year period. In addition, methane contributes to the formation of ground-level ozone – also a greenhouse gas and a key component of smog which causes negative impacts on both human health and vegetation.

[Canada's National Inventory Report on Greenhouse Gas Sources and Sinks](#) documents Canada's annual GHG emissions estimates, and covers methane as well as carbon dioxide, nitrous oxide, perfluorocarbons, hydrofluorocarbons, sulphur hexafluoride and nitrogen difluoride. Canada's first GHG inventory was prepared in 1992, followed by a second in 1994. Since 1996, GHG inventories have been prepared and submitted to the UNFCCC (United Nations Framework Convention on Climate Change) annually.

Based on Canada's 2017 National GHG Inventory Submission, Canada's total methane emissions in 2015 were estimated to be 4,096 kt, or 102,400 kt in carbon dioxide equivalent, making methane Canada's second most important GHG, after carbon dioxide. Nationally, methane emissions have increased by 9%, or 355 kt, since 1990 (Figure 2). Increases since 1990 are due largely to oil and gas development, although emissions have also increased across other methane sources such as the agriculture and waste management sectors. Projections based on 2015 data indicate that methane emissions will decrease by 16% relative to 2012 emissions levels by 2025 (Tables 4 and 5). This reduction is largely due to proposed federal regulations to reduce methane emissions from the oil and gas sector by 40-45%. The complete list of GHG mitigation measures reflected in the projections is provided in Appendix C.

Table 3 provides an overview of methane emissions by sector; within each sector, there is a single source accounting for the majority of methane emissions. Methane emissions in this section are therefore discussed in terms of the major emission source within each sector.

Oil and Natural Gas - Fugitives, Venting and Flaring

Fugitive emissions are intentional or unintentional releases from the production, processing, transmission, storage and delivery of fossil fuels. Fugitive methane emissions from oil and natural gas production and processing represent the largest source of methane emissions in Canada. In 2015, fugitive emissions from oil and natural gas contributed 1,722 kt of methane to the atmosphere, or 42% of overall methane emissions.

Fugitive methane emissions from the oil and gas sector have fluctuated since 1990, peaking in 1998 at 2127 kt of emissions as a result of growth in the oil and gas sector. Emissions have decreased overall since this peak due to improved inspection, maintenance programs, better industry practices, technological improvements and regulations. Nonetheless, fugitive emissions from the oil and natural gas sector in 2015 were 25% greater than emissions from the sector in 1990.

Fugitive methane emissions from the oil and gas sector are projected to decline to almost half of the current levels by 2030, mainly due to the upstream oil and gas methane regulations published in May 2017.

Agriculture

Nearly all methane emissions within the agricultural sector come from livestock, primarily cattle. The most prominent source of methane emissions within the agricultural sector is enteric fermentation, though manure management also contributes to emissions. Enteric fermentation refers to the herbivore digestion process, a by-product of which is methane. In 2015, enteric fermentation produced 1000 kt of methane, or 24%, of overall methane emissions.

The main driver of methane emission trends in the agriculture sector are fluctuations in livestock populations. Between 1990 and 2005, high commodity prices led to an increase in the population of beef cattle, corresponding with an increase in methane emissions. In the following year, a drop off in methane emissions followed a decrease in beef prices after an outbreak of mad cow disease in 2003. In recent years, animal commodity prices have increased, and animal populations and methane emissions from livestock have stabilized. In 2015, agricultural methane emissions of methane were 9% above 1990 levels. Methane emissions are projected to remain relatively flat to 2030.

Waste

Methane emissions from solid waste disposal include emissions from municipal solid waste landfills, as well as wood waste landfills and wastewater treatment. Solid waste disposal accounts for the majority of methane produced by waste. In 2015, solid waste disposal accounted for 886 kt of methane emissions, or 22% of overall methane emissions. This represents a 3% increase over 1990 emissions levels (861 kt).

This modest increase comes despite a 29% population growth over the same time period. Emissions of methane from landfills increased between 1990 and 2006, peaking at 1015 kt of emissions. Introduction of landfill gas capture contributed to containing the growth of methane emissions, and to actual

emissions reductions between 2006 and 2012. A gradual increase in emissions since 2012 reflects a plateauing number of active landfills and the quantity of landfill gas collected.

Methane emissions from solid waste are expected to increase by 11% by 2025 compared to 2015 in accordance with expected growth in population.

Other

Emissions from all other sources of methane include those from fossil fuel combustion, coal mining and handling, manure management, and wastewater treatment discharge. Combined, all other sources emitted 488 kt in 2015, representing about 12% of total methane emissions.

Land Use and Land-Use Change and Forestry

The Land Use, Land-use Change and Forestry (LULUCF) sector includes exchanges of GHGs between the atmosphere and Canada’s managed lands, including GHGs associated with harvested wood products. In all years since 1990, the LULUCF sector is a carbon sink, despite net positive emissions in methane within the sector. Emissions in 2015 continued this trend, with the LULUCF accounting for a net removal of 34,000 kt of GHG emissions, despite contributing 40 kt of methane to the atmosphere.

Consistent with Canada’s practice under UNFCCC reporting, LULUCF emissions are removed from overall methane estimates in this report.

Figure 2: Trends in Canada’s Methane emissions by Largest Contributing Sources, excluding LULUCF

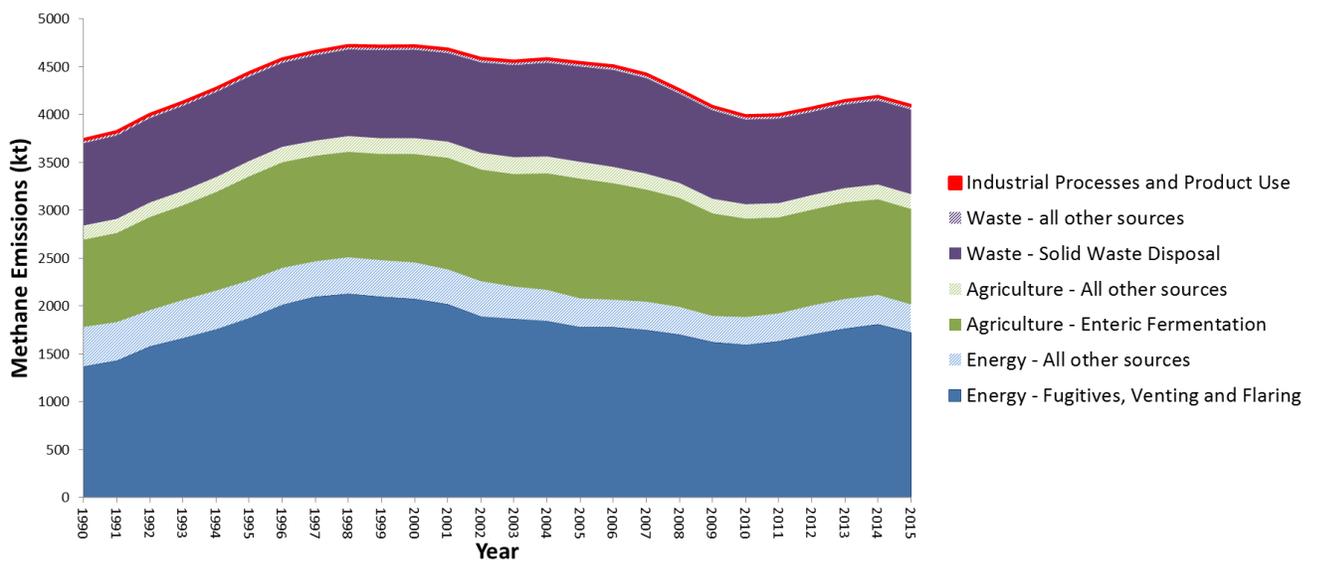


Table 3: Canadian Methane Emissions by Sector (2015), based on Canada’s 2017 National GHG Inventory Submission to the UNFCCC

| | (kt) | % of total |
|--|----------------|---------------|
| Energy | 2017.24 | 49 |
| Fuel Combustion | 249.50 | 6 |
| Energy industries | 91.73 | 2 |
| Manufacturing industries and construction | 4.53 | < 1 |
| Transport | 21.58 | 1 |
| Residential and other sectors | 131.65 | 3 |
| Other | 0.01 | < 1 |
| Fugitive emissions from fuels | 1767.74 | 43 |
| Solid fuels | 45.58 | 1 |
| Oil and natural gas | 1722.17 | 42 |
| Industrial processes and product use | 2.98 | < 1 |
| Chemical industry | 2.91 | < 1 |
| Metal industry | 0.07 | < 1 |
| Agriculture | 1152.00 | 28 |
| Enteric fermentation | 1000.18 | 24 |
| Manure management | 150.14 | 4 |
| Field burning of agricultural residues | 1.68 | < 1 |
| Waste | 923.77 | 23 |
| Solid waste disposal | 885.86 | 22 |
| Biological treatment of solid waste | 21.89 | 1 |
| Incineration and open burning of waste | 0.26 | < 1 |
| Wastewater treatment and discharge | 15.76 | < 1 |
| Total methane emissions (without methane from LULUCF) | 4096.00 | 100 |

Figure 3: Canadian Methane Emissions by Sector (2015), based on Canada’s 2017 National GHG Inventory Submission to the UNFCCC

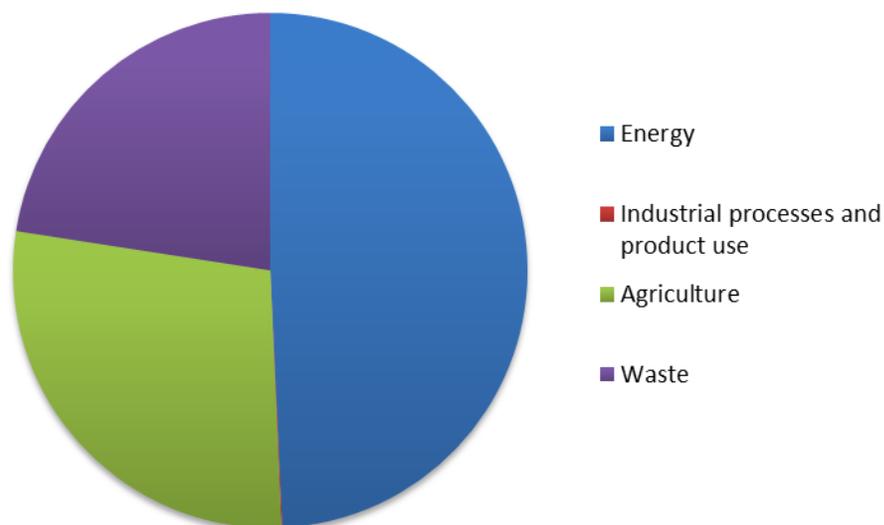


Table 4: Methane Projections by Sector

A complete list of federal, provincial and territorial measures reflected in these projections is provided in Appendix C.

| | (kt) | 2020 | 2025 | 2030 |
|--|------|-------------|-------------|-------------|
| Energy | | 1722 | 1214 | 1244 |
| Fuel Combustion | | 245 | 246 | 250 |
| Fugitive emissions from fuels | | 1478 | 967 | 994 |
| Industrial processes and product use | | 3 | 4 | 4 |
| Agriculture | | 1128 | 1155 | 1144 |
| Waste | | 992 | 1029 | 1059 |
| Total methane emissions (without methane from LULUCF) | | 3846 | 3401 | 3451 |

Figure 4: Projections of Canada’s Methane Emissions by Source to 2030, excluding LULUCF

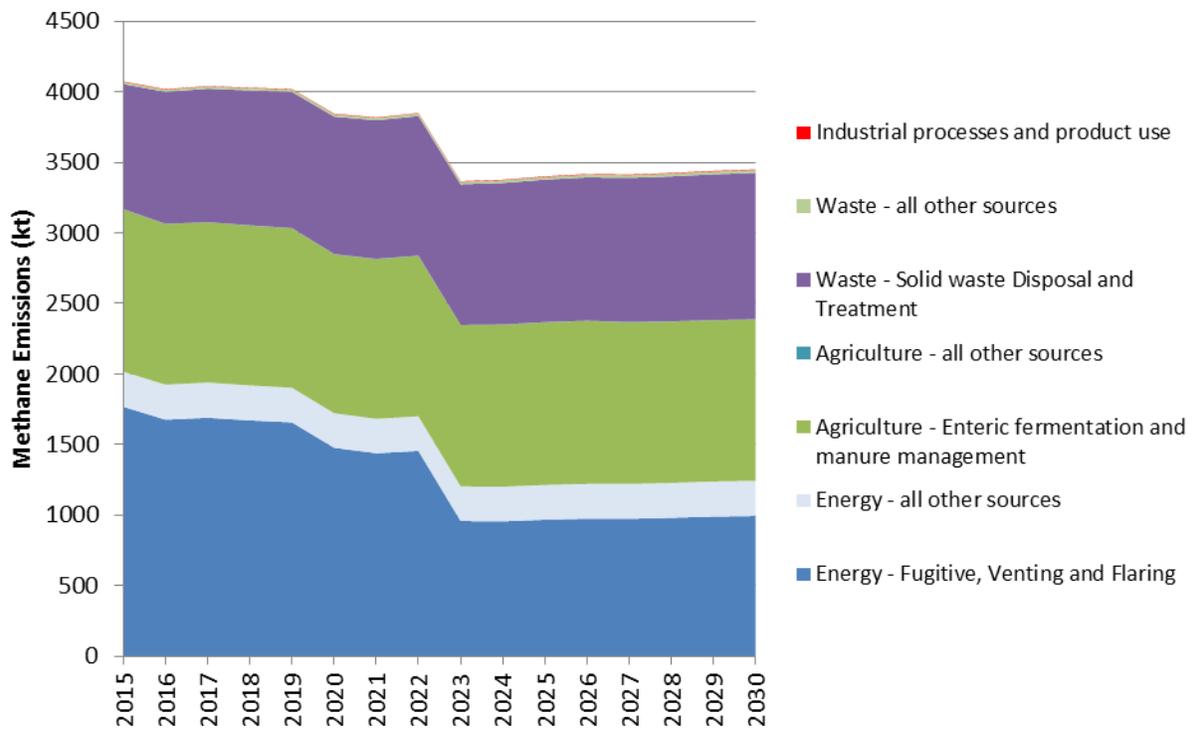


Table 5: National Methane Projections by Year

| | Total Estimated Emissions of Methane (kt) |
|----------------------------|--|
| 2012 | 4070 |
| 2013 | 4148 |
| 2014 | 4191 |
| 2015 | 4096 |
| 2016 | 4019 |
| 2017 | 4042 |
| 2018 | 4030 |
| 2019 | 4020 |
| 2020 | 3846 |
| 2021 | 3819 |
| 2022 | 3850 |
| 2023 | 3366 |
| 2024 | 3377 |
| 2025 | 3401 |
| 2026 | 3417 |
| 2027 | 3414 |
| 2028 | 3425 |
| 2029 | 3440 |
| 2030 | 3451 |
| Inventory values in green | |
| Projected values in purple | |

Chapter 3: Summary of National Actions, National Action Plans, Mitigation Strategies

In Canada, protection of the environment is a shared responsibility between the federal, provincial, and territorial governments. The Government of Canada recently released two documents which describe Canada's approach to mitigation of methane and black carbon emissions (alongside other GHGs and SLCPs): the Pan-Canadian Framework on Clean Growth and Climate Change, and Environment and Climate Change Canada's Strategy on Short-Lived Climate Pollutants. A number of provinces and territories have also released climate change plans that will impact emissions of black carbon and methane.

In addition to these publications, federal, provincial and territorial governments have implemented a broad range of regulatory and non-regulatory measures that reduce, or will reduce, black carbon and methane emissions. This chapter highlights key examples of ongoing and planned approaches and initiatives that will reduce emissions of black carbon and methane within Canada. A more comprehensive list of these measures can be found in the appendices. These lists should not be considered exhaustive.

Summary of the Pan-Canadian Framework on Clean Growth and Climate Change

[The Pan-Canadian Framework on Clean Growth and Climate Change](#) outlines Canada's plan to meet emissions reduction targets under the Paris Agreement and to grow the economy. The Framework rests on four main pillars: pricing carbon pollution; complementary measures to further reduce emissions across the economy; measures to adapt to the impacts of climate change and build resilience; and actions to accelerate innovation, support clean technology, and create jobs. The Pan-Canadian Framework outlines specific actions and commitments to reduce emissions of methane within the oil and gas sector, and also includes actions that could help reduce agricultural methane, as well as actions that will, as a co-benefit, reduce emissions of black carbon. These actions include improving energy efficiency, reducing emissions in the transportation sector, and reducing reliance on diesel in northern and remote communities.

Summary of the Strategy on Short-Lived Climate Pollutants

Complementary to the Pan-Canadian Framework, and to help guide future actions in reducing SLCPs such as black carbon and methane, Environment and Climate Change Canada published a [Strategy on Short-Lived Climate Pollutants](#) in July 2017. The SLCP Strategy addresses SLCPs through five pillars for action: enhancing domestic mitigation efforts; enhancing science and communications to broaden understanding; engaging internationally and building partnerships and relationships to reduce SLCPs; improving coordination of ECCC and other Government of Canada activities; and collaborating with provincial and territorial governments and other partners. The SLCP Strategy reaffirms commitments from the Pan-Canadian Framework and details additional commitments and new and ongoing actions to address black carbon and methane.

Best Practices and Lessons Learned: National Approach to Black Carbon and Methane Mitigation

Although SLCPs including black carbon and methane are increasingly part of the dialogue on climate change, the importance of SLCP mitigation and the multiple benefits it can achieve are not always understood. Efforts to increase understanding of SLCPs within policy communities and to the general public can help to promote SLCP mitigation as a fundamental component of strategies to mitigate climate change, in parallel with near-term action on CO₂.

Domestic mitigation, science and international work are increasingly linked. In addition, capabilities in SLCP mitigation extend beyond governments, and include industry and citizens. Therefore, effective mitigation action should leverage the knowledge, capacity and engagement of a broad suite of actors in Canada, including cities, municipalities, academia, government agencies, non-governmental organizations, the private sector, and Indigenous communities. Increased collaboration with provincial and territorial partners, who hold many SLCP policy levers and are important actors in SLCP mitigation, is needed in order to coordinate action and drive emission reductions across key sources. In Canada, collaborative work on air pollution is being advanced through the Air Quality Management System. Increased cooperation between government and industry, such as the work being undertaken by Sustainable Development Technology Canada, fosters innovation in clean energy and other environmental solutions. In particular, Canadian Inuit and the organizations which represent them are key partners in Arctic governance, and must be involved in the conception, development and implementation of Arctic climate change and air pollution mitigation actions. Development of an Arctic policy framework in Canada (discussed in Chapter 6) will help foster an integrated policy environment, advancing key environmental policies, both domestically and internationally.

Canada continues to support the best practices and lessons learned identified in the [Expert Group on Black Carbon and Methane Summary of Progress and Recommendations](#), released in May 2017.

Summary of Black Carbon Mitigation Actions

Black carbon reductions in Canada result from a range of measures and regulations that reduce air pollution throughout the country, and as a co-benefit of measures that reduce GHGs. Research and development also play an important role in Canada's approach to black carbon mitigation. Sustainable Development Technology Canada (SDTC) is a foundation created by the Government of Canada in 2001 to invest in clean technologies. SDTC has supported over 300 projects to date that address climate change, air quality, clean water and clean soil. In addition, a number of provinces, territories, and municipalities have implemented measures that reduce emissions of black carbon.

Since the publication of the [2015 National Black Carbon and Methane Report](#), considerable progress has been made to address black carbon emissions, building upon existing federal, provincial and territorial measures. This section focuses on Canada's progress over the past two years, and on new actions to be introduced in the near-term. A more detailed (but not exhaustive) list of black carbon mitigation measures, extending beyond the past 2 years, can be found in Appendix A.

Best Practices: Black Carbon Mitigation

Certain measures have a greater impact in terms of reducing emissions of black carbon than others. Measures that will reduce black carbon emissions and that target some of the highest emitters of black carbon within Canada include:

- Regulating emissions from fuels, new vehicles, and engines;
- Promoting clean burning of biomass through public education, guidelines, and by-laws;
- Phasing out coal-fired electricity generating units and promoting the use of clean electricity ;
and
- Helping remote communities reduce reliance on diesel for electricity and heating.

Although emissions of black carbon from stationary diesel engines are relatively low compared to other sources, these emissions are of particular concern in many northern, remote and Indigenous communities in Canada. Many communities in the Canadian Arctic are not connected to the North American electricity grid, and are reliant on local diesel generators for power. Diesel engines which operate 24-hours a day, often in proximity to homes and schools, constitute a local noise, health and environmental concern. Further, the effects of black carbon on the reflectivity of the earth's surface are particularly pronounced over ice and snow. Efforts being undertaken by the Government of Canada to reduce the reliance on diesel and to promote the use of cleaner energy sources in northern communities are locally quite important.

Air Quality Management System

Black carbon mitigation is being addressed through air pollution measures targeting PM_{2.5} sources known to result in significant black carbon emissions, or that have significant regional impacts, such as in the Arctic or in densely populated areas. Canada is implementing a nation-wide Air Quality Management System in collaboration with provinces and territories to improve air quality across the country. To drive air quality improvements, the federal government established 24-hour and annual Canadian Ambient Air Quality Standards (CAAQS) for PM_{2.5} under the *Canadian Environmental Protection Act, 1999* in 2013. The 24-hour CAAQS for PM_{2.5} is currently set at 28 µg/m³, and will become more stringent in 2020 at 27 µg/m³. Similarly, the annual CAAQS for PM_{2.5} is currently set at 10.0 µg/m³ and will decrease to 8.8 µg/m³ in 2020. The CAAQS are underpinned by air quality management levels, which call for progressively more rigorous actions by jurisdictions as air quality approaches or exceeds the CAAQS thereby ensuring that the CAAQS are not treated as “pollute-up-to” levels. A review of these CAAQS is expected during the coming years, to ensure that they remain adequate to protect the health of Canadians and the environment. Regulatory and non-regulatory measures are being implemented by governments to reduce air pollutant emissions of PM_{2.5} from industrial and non-industrial sources.

Canada's approach to reducing GHG emissions has resulted in regulations that also achieve black carbon reductions.

Transportation and Mobile Equipment

Some of Canada's most significant measures impacting black carbon have been taken in the transportation sector. Current federal regulatory measures focus on emissions from fuels as well as new vehicles and engines. These will continue to result in black carbon emission reductions as fleets turn over.

Proposed amendments to the Off-Road Small Spark-Ignition Engine Emissions Regulations were put forward in 2016 which would establish more stringent standards for air pollutants from exhaust systems of engines designed to be used in handheld machines. These regulations will result in further decreases in exhaust and evaporative emissions of air pollutants, including PM_{2.5}, a component of which is black carbon. Draft regulations, including exhaust emissions standards for the rail sector were also published in 2016. In January 2017, amendments to the On-Road Vehicle and Engine Emission Regulations came into effect, requiring stricter, Tier 3 emissions standards for new passenger cars, light-duty trucks and heavy-duty vehicles.

The Pan-Canadian Framework includes a number of actions to reduce emissions from the transportation sector, including regulations for heavy- and light-duty vehicles, actions to increase the use of zero-emission vehicles and a variety of investments. Proposed regulations amending the Heavy-duty Vehicle and Engine Greenhouse Gas Emissions Regulations were put forward in March 2017. These amendments would introduce more stringent GHG emissions standards for new heavy-duty vehicles and trailers hauled by on-road transport tractors; these would lead to decreases in fuel consumption and hence reductions in emissions of smog-forming air pollutants, including PM_{2.5}. Additionally, these amendments would include standards for particulate matter emissions from tractors equipped with auxiliary power units, which are known sources of particulate matter. The Government of Canada also announced \$17.2 million in funding over five years to develop and implement heavy-duty vehicle retrofit and off-road regulations and a clean fuel standard. Canada has committed to implementing increasingly stringent emissions standards for light-duty vehicles, developing a Canada-wide strategy to promote the deployment of zero-emission vehicles, investing in public-transit upgrades and alternative fuel transportation hubs and ports, and developing a clean fuel standard to reduce emissions from fuels used in transportation, buildings and industry.

Additionally, provinces and territories have implemented measures focusing on existing vehicles, on- and off-road diesel vehicles and engines. Provincial and territorial measures include transportation programs and policies such as motor vehicle inspections and scrappage programs. In December 2015, British Columbia and Quebec joined the International Zero Emission Vehicle Alliance, announcing the intention to make all new passenger vehicles within their jurisdictions zero-emission by no later than 2050. Quebec has also reduced emissions through the implementation of its Transportation Electrification Action Plan, including a Drive Electric Program (purchase rebate) and deployment of infrastructure to accelerate the deployment of electric vehicles, including a public charging station network. Several programs aimed at encouraging the use of green transportation have also been effective in provinces across Canada.

Commercial/Residential/Institutional

The Canadian Council of Ministers of the Environment (CCME), an intergovernmental forum of federal, provincial and territorial Ministers of the Environment in Canada that facilitates collective action on environmental issues of national and international concern, continues to be a leader in the development of measures to address black carbon and other air pollutants from biomass burning. Complementary to its code of practice and model municipal bylaw for residential wood-burning appliances, the CCME published in 2016 a Guidance Document for Canadian Jurisdictions on Open-Air Burning. The guidance document assists governments, municipalities and Aboriginal communities with their response to air quality problems associated with open-air burning, including emissions of black carbon, by providing flexible guidance options for addressing wood smoke problems. The document outlines general directions for open-air burning, and describes tools for regulating open-air burning, air quality advisories and burn restrictions, alternatives to open-air burning, public outreach and education, and performance management advice.

Provinces and territories, and even certain municipalities continue to manage emissions from wood smoke through a variety of regulations, guidelines and codes of practice which vary widely between jurisdictions. Since the publication of the last edition of Canada's National Black Carbon and Methane Report in 2015, several provinces and territories have enhanced efforts to reduce emissions from commercial, residential and institutional wood-burning. For instance, the City of Montreal has put in place stringent standards for wood-burning stoves and fireplaces; wood-burning stoves in Montreal must be certified to show they emit no more than 2.5 grams of PM_{2.5} per hour by 2018, and cannot be used on smog days. In November 2016, British Columbia put in place new solid fuel burning appliance regulations to reduce the amount of particulate matter emitted by wood burning appliances. All new wood burning appliances sold in British Columbia must now be certified to meet particulate matter emissions standards set by the US EPA in 2015, or equivalent standards. Woodstove change-out programs are currently available in British Columbia, Nova Scotia, New Brunswick and Ontario. Ontario's new Climate Action Plan (2016-2020) included up to \$4 million in funding to help retire older wood stoves. This program is being piloted in targeted northern and rural Indigenous communities and includes an educational campaign that presents an overview of modern wood heating appliance options, and the importance of proper burning techniques. In addition, this program will create economic incentives to increase the efficiency of wood heating systems, and to displace the use of fossil fuel-based heating systems in target communities with modern wood heating appliances.

Under Canada's SLCP Strategy, risk management options to address emissions from residential wood burning appliances will be considered by the federal government, in collaboration with provinces and territories, in the medium and long term.

Ore and Mineral Industries

In 2016, Environment and Climate Change Canada published two codes of practice to address particulate matter emissions from ore and mineral industries. The Code of Practice to Reduce Emissions of Fine Particulate Matter (PM_{2.5}) from the Aluminium Sector enumerates sources of particulate matter

arising from the primary aluminium sector, and operating procedures and best practices to control and reduce emissions of PM_{2.5} for each primary operation activity

The Code of Practice to Reduce Fugitive emissions of Total Particulate Matter and Volatile Organic Compounds from the Iron, Steel and Ilmenite sector is a resource to encourage continual improvement in environmental performance of fugitive emissions of total particulate matter. The document provides recommendations and best practices on methods for minimizing the release of fugitive emissions of total particulate matter, including practical advice on materials handling, movement and storage, cokemaking, ironmaking, steelmaking and steel finishing.

Oil and Gas Industry

Canada's recent endorsement of the World Bank's Zero Routine Flaring by 2030 initiative will support reductions in black carbon emissions resulting from routine flaring at oil production facilities. Provinces such as Alberta, British Columbia and Saskatchewan have also independently implemented measures to reduce flaring from oil and gas operations.

Electric Power Generation (Utilities)

Since becoming the first major coal-user to ban the construction of traditional coal-fired electricity generating units in 2012, Canada has continued work to reduce emissions from coal-fired generation of electricity. In November 2016, Canada announced that it would accelerate the phase out of coal-fired electricity and aim to produce 90% of its electricity from renewable sources by 2030. Enhanced domestic actions to limit the use of coal and to promote the use of clean electricity technologies will decrease emissions of GHGs, as well as black carbon. The Government of Canada has also committed to reduce its own GHG emissions to 40 percent below 2005 levels by 2030 or earlier and also set a goal of using 100 percent clean power by 2025.

The Pan-Canadian Framework includes additional actions to increase renewable and non-emitting energy sources, connect clean power with places that need it, modernize electricity systems, and reduce reliance on diesel in northern and remote communities. Many northern, remote and Indigenous communities in Canada are not connected to the North American electricity grid, and are reliant on local diesel generators for power. Reducing reliance on diesel will result in reduced emissions of black carbon and other pollutants. Canada's 2017 federal Budget provided \$21.4 million over four years to help reduce reliance on diesel for electricity and heating in northern, remote and Indigenous communities; \$220 million to reduce the reliance of rural and remote communities south of the 60th parallel on diesel fuel, and to support the use of more sustainable, renewable power solutions; and \$400 million in an Arctic Energy Fund to address energy security for communities north of the 60th parallel.

In addition, in support of these commitments and in line with Canada's SLCP Strategy, in November 2016, regulatory development was initiated for new stationary diesel (compression-ignition) engines. The proposed regulations would set standards to reduce emissions of air pollutants including carbon monoxide, volatile organic compounds, nitrogen oxides and particulate matter (including black carbon).

Provincial and territorial measures have also been instrumental in moving Canada towards lower-emitting forms of energy. Provinces and territories have already taken action on moving from traditional coal-fired generation to clean electricity. Ontario and Manitoba have phased out their use of coal. In 2015, Ontario passed the Ending Coal for Cleaner Air Act, permanently banning coal-fired electricity generation in the province. Alberta has plans in place to phase out coal-fired electricity in 2030, while Nova Scotia has created a regulatory framework to transition from coal to clean electricity generation. Saskatchewan has a coal-fired generating unit with carbon capture technology, which can capture up to 90 percent of CO₂ emissions, and has announced its intention to generate 50% of its electricity using renewable energy by 2030.

Summary of Methane Mitigation Actions

Many current and planned GHG regulatory and non-regulatory measures at the federal, provincial and territorial levels are aimed at reducing methane emissions in Canada.

Since the publication of the 2015 National Black Carbon and Methane Report, Canada has made taking action on GHGs a key priority. This section focuses on Canada's progress over the past two years towards developing and refining measures and programs to address methane emissions, and on new actions to be introduced in the near-term.

A detailed (but not exhaustive) list of methane mitigation measures, extending beyond the last two years, can be found in Appendix B.

Best Practices: Methane Mitigation

Canada takes action on methane emissions through a variety of measures targeting emitters across source categories. Certain measures have a greater impact in terms of reducing emissions of methane than others. Some of the most effective measures for reducing methane emissions within Canada include:

- Regulating the release of methane from the oil and gas sector;
- Promoting the creation and adoption of technologies, practices and processes that reduce the production of greenhouse gases, including methane;
- Regulating and/or incenting the use of landfill gas collection systems;
- Promoting the prevention, reuse and recycling of waste

Oil and Natural Gas - Fugitives, Venting and Flaring

Canada has committed to reduce methane emissions from the oil and gas sector by 40-45% below 2012 levels by 2025. To achieve this goal, Canada will implement federal methane regulations for the oil and gas sector, which will address Canada's largest source of methane emissions and provide clear and consistent requirements across the country. In May 2017, Canada published proposed Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector). Announced measures to address methane from oil and gas sources will reduce Canada's largest source of methane emissions, with co-benefit reductions of some ozone precursors, and contribute to Canada's GHG emissions reduction targets.

Another means by which the Government of Canada promotes more sustainable practices in the oil and gas sector is through funding to clean technology research and development. Natural Resources Canada's Energy Innovation Program (EIP) supports projects focused on renewable energy; smart grids and storage systems; reducing diesel use; methane and VOC emission reduction; reducing GHG emissions in the building sector; carbon capture, use and storage; and improving industrial efficiency. One recently funded project under the EIP includes the Gas Seepage Project (GaSP), led by Dalhousie University and including partners from other Canadian academic institutions and from local industry partners. This project aims to build scientific understanding of how historical fossil fuel extraction sites continue to affect the present-day atmosphere. The research team is building an inventory of methane emission estimates from abandoned mining and oil and gas extraction sites in Nova Scotia and New Brunswick.

Several provinces have also made commitments to reduce emissions from the oil and gas sector. Alberta announced in November 2015 a goal to cut methane emissions by 45% from oil and gas operations by 2025. Alberta has published an offset protocol for certain venting source reductions (pneumatic equipment). In British Columbia's Climate Leadership Plan released in 2016, the province set a target to reduce methane emissions from oil and gas extraction and processing infrastructure built before January 1, 2015, by 45 percent by 2025. British Columbia is also offering incentives to reduce emissions from applications built between 2015 and 2018 with a Clean Infrastructure Royalty credit program, as well as a new offset protocol.

Agriculture

Canada's agricultural and agri-food sector continues to implement Growing Forward 2 – a federal-provincial-territorial cost-shared program which, among other initiatives, funds on-farm planning and incentivizes accelerated action to reduce environmental impacts. Additionally, the Agricultural Greenhouse Gases Program (AGGP) supports projects that enhance the understanding and accessibility of agricultural technologies, beneficial management practices and processes that can be adopted by farmers to mitigate GHG emissions in Canada. Applicants to the AGGP may request up to \$2 million of support for projects that create technologies, practices and processes that can be adopted by farmers to mitigate greenhouse gas emissions. Originally intended to run until August 2015, this program has been successful in helping to promote the sustainability of agricultural production in Canada, and is making progress towards making GHG mitigation information and technologies available to farmers. The program has now been extended until 2021. In July 2017, the Government of Canada announced \$1.1 million in funding for the University of Lethbridge to study ways to reduce methane gas emissions in cattle. This project is one of 20 new research projects supported by the \$27 million AGGP. Development of the Canadian Agricultural Partnership will be launched in 2018, and will address feed innovations and other opportunities to reduce methane emissions from cattle.

Federal initiatives complement ongoing provincial efforts to optimize environmental practices in the agricultural sector, including Quebec's Prime-Vert program. Prince Edward Island is employing the use of robotics in dairy farming and food additives in livestock production to reduce methane emissions.

Academic institutions also have a strong role to play in innovating to reduce emissions from agriculture. For instance, the Efficient Dairy Genome Project, funded by Genome Canada, is an international Canadian-led project including researchers from Ontario, Alberta, Australia, USA, United Kingdom and Switzerland. The project aims to provide cost-effective, genomic-based methods to allow selection of dairy cattle with improved feed efficiency and lower methane emissions, ultimately decreasing the environmental footprint of the dairy industry. Preliminary estimates show that advanced breeding techniques and increased feed efficiency can reduce methane emissions by an estimated 11-26%.

Waste

As a result of provincial regulations and incentives, 68 of the 88 medium and large-sized landfills in Canada have gas collection systems, and the number of landfill sites with capture systems continues to rise in Canada. Gas collected from these landfills is used for many purposes, including the generation of heat and electricity. Ontario has regulations requiring landfills over 1.5 million m³ to install landfill gas collection systems, while British Columbia requires landfills generating over 1,000 tonnes of methane to install a landfill gas management system that collects a minimum of 75% of emissions. Other provinces, including New Brunswick, Newfoundland and Labrador, and Quebec also encourage methane capture.

There is a growing body of evidence that identifies waste prevention, reuse and recycling as the largest source of untapped potential for GHG reductions in the waste sector. Many Canadian provinces, territories and municipalities have implemented programs to support improved waste management practices, including regulations aimed at diverting waste away from landfills. For instance, 70% of Nova Scotia's organic waste is currently diverted from landfills.

Under the United Nations Sustainable Development Goals, and in the June 2016 North American Leaders' Statement, Canada committed to work towards reducing food waste by 50%. Consultations on strategies to reduce avoidable food waste, increase organics diversion, and increase recycling and reuse began in 2017.

Federal funding programs continue to be an effective mechanism helping to support initiatives across Canada that promote recycling, organics processing, and technologies such as landfill gas capture. Additional measures identified in consultation with provinces and territories, requiring or incenting the capture of landfill gas are being advanced through new funding received under Budget 2016.

Chapter 4: International cooperation

Canada's domestic efforts to address emissions of black carbon and methane are complemented by active engagement in SLCP work internationally. Recognizing that impacts of SLCPs do not respect national or regional borders, Canada works internationally to address emissions of black carbon and methane under a variety of multilateral fora.

Summary of International and Regional Actions to Address Black Carbon and Methane

Arctic Council

The Arctic Council was one of the first fora to recognize the importance of taking action to address SLCPs, including black carbon and methane. The Arctic Council includes three individual Expert Groups with distinct mandates focused on SLCPs – the Arctic Monitoring and Assessment Program's Short Lived Climate Pollutant Expert Group (AMAP SLCPEG), the Expert Group on Black Carbon and Methane (EGBCM), and the Arctic Contaminants Action Program's Expert Group on Short Lived Climate Pollutants (ACAP EG-SLCP). Canada is active under each of these Expert Groups.

AMAP monitors and assesses the status of the Arctic by documenting levels and trends, pathways and processes, and effects on ecosystems and humans, and proposes actions to reduce associated threats for consideration by governments. The work of the SLCPEG under AMAP focuses on levels and trends in SLCPs, as well as understanding how SLCPs will impact future Arctic climate. Canada is actively involved in preparations for the 2019 interim report, as well as for the 2021 scientific assessment.

The EGBCM implements commitments to take “enhanced, ambitious, national and collective action to accelerate the decline in our overall black carbon emissions and to significantly reduce our overall methane emissions”. This includes biennial submission of this report, national inventories of black carbon and methane and, if available, projections of future emissions. This Expert Group was also responsible for the development of an ambitious, aspirational and quantitative collective goal on black carbon, adopted by the Arctic Council in 2017. In their 2017 Summary of Progress and Recommendations, the EGBCM recommended that black carbon emissions be further collectively reduced by at least 25-33 percent below 2013 levels by 2025. The report also makes 12 recommendations for enhanced policy action focused on four sectors where large near-term gains are possible: diesel-powered mobile sources; methane leakage, venting and flaring in the oil and gas sector; residential biomass combustion; and solid waste disposal. Canada is well positioned to adopt most of the recommendations in the report, including measures related to diesel-power vehicles and engines; methane leakage, venting and flaring in the oil and gas sector; and solid waste disposal. Canada is doing its part to achieve the collective goal. Based on current projections, Canada's black carbon emissions in 2025 are expected to be at least 26% below the 2013 level (Table 2).

The ACAP EG-SLCP develops pilot projects that build capacity and demonstrate SLCP emission reduction activities in Arctic States, and thereby encourages national actions to reduce environmental, human health and socio-economic risks associated with SLCPs. Under the current Finnish Chairmanship of the

Arctic Council, the ACAP work plan includes eight pilot projects targeting SLCP emissions – these projects are largely concentrated in the Russian Arctic, however some activities extend across the circumpolar Arctic.

Climate and Clean Air Coalition

The Climate and Clean Air Coalition (CCAC) is a voluntary partnership of governments, intergovernmental organizations, businesses, scientific institutions and civil society organizations committed to improving air quality and protecting the climate through actions to reduce SLCPs. Canada has increased its engagement in the CCAC by serving as co-chair of the CCAC Working Group, the operational decision-making body of the Coalition, for the 2016-2018 period. In addition, CCAC funding provided by Canada, as well as other CCAC Partners, is helping to reduce SLCP emissions from key industrial sectors in developing countries, contributing to Canada's international objectives on climate change and reducing the rate of near-term warming. Black carbon and methane initiatives under the CCAC focus on practical action in ten key areas: diesel, oil and gas, waste, bricks, household energy, agriculture, supporting national action and planning on SLCPs, finance, assessments, and health.

Commission for Environmental Cooperation

To address the nexus between trade and environmental issues, Canada, Mexico, and the United States signed the North American Agreement for Environmental Cooperation in 1994, which, among other things, established the Commission for Environmental Cooperation (CEC). The CEC facilitates cooperation on shared priorities of the three countries on trade and environment to advance sustainable growth in North America while protecting the environment, ecosystems and health. Cooperative projects on environment, trade, and sustainability, strategic stakeholder and partner engagement, and support for action at the community level, including projects focused on improving air quality and decreasing emissions of GHGs and SLCPs, deliver on the Commission's objectives. For instance, the 2017-2018 Operational Plan includes a project to improve black carbon inventories from small scale biomass, to reduce pollution from maritime transport, and to measure and mitigate food loss and food waste.

Global Methane Initiative

Launched in 2004, the Global Methane Initiative (GMI) targets methane abatement, recovery, and use by focusing on biogas, coal mines, and oil and gas systems. The GMI brings together governments, nongovernmental organizations and the private sector to reduce global methane emissions and advance the use of methane as a clean energy source. The GMI is represented by countries with large sources of methane and/or special expertise and interest in developing methane projects. GMI Partner Countries account for approximately 70 percent of global anthropogenic methane emissions. Canada currently co-chairs the GMI alongside Mexico, participates in all of the subgroups, and will host the Global Methane Forum in April 2018.

International Maritime Organization

Canada is providing expert technical support, policy advice, and emissions testing expertise relating to air pollutant and greenhouse gas emissions from ships, as the International Maritime Organization (IMO; the UN agency responsible for setting global standards applicable to international shipping) develops and implements a work plan to assess the impacts of black carbon emissions from ships on the Arctic environment. Canada also provides input to the IMO relating to fugitive volatile organic compounds (VOCs) from tankers.

North American Climate, Clean Energy and Environment Partnership

The North American Leaders' Summit was held in Ottawa in June 2016 in Ottawa, Canada. During this summit, the North American Climate, Clean Energy, and Environment Partnership was announced jointly by the Prime Minister of Canada and the Presidents of the United States and Mexico. This Action Plan includes a commitment to drive down SLCPs by reducing methane emissions in the oil and gas sector, developing national methane strategies with a focus on key sectors, decreasing methane emissions from landfills and the agriculture sector, reducing black carbon, and reducing hydrofluorocarbons.

United Nations Economic Commission for Europe

Under the United Nations Economic Commission for Europe (UNECE), Canada is a signatory to the Convention on Long-Range Transboundary Air Pollution (CLRTAP). The Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone, which is part of CLRTAP, addresses pollutants that cause acid rain, the formation of smog and ozone and the degradation of water bodies due to eutrophication. The Gothenburg Protocol became the first legally-binding international treaty to explicitly include SLCPs when it was amended in 2012 to include PM_{2.5}. Canada ratified the Gothenburg Protocol on November 28, 2017 signaling Canada's commitment to international efforts to address transboundary air pollution and SLCPs. Following ratification, Canada will submit, for key air pollutants, ceilings for 2010 which must be maintained and indicative emissions reduction commitments for 2020 for automatic incorporation into the Gothenburg Protocol. Additionally, Canada has submitted black carbon inventory annually to the UNECE since 2015. Submission of an annual black carbon inventory is a voluntary commitment under the Gothenburg Protocol.

United Nations Framework Convention on Climate Change

Methane is one of the seven GHGs measured and reported on under the UNFCCC. Canada reports its methane emission in its annual National Inventory and describes mitigation actions, measures, and estimates for methane projections in its Biennial Report, entitled [Canada's Biennial Report on Climate Change](#), to the UNFCCC.

Building upon the UNFCCC, the Paris Agreement aims to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. Nationally Determined Contributions (NDCs) communicate internationally the action that a

country will implement in order to help meet the goals under the Paris Agreement. Countries commit to strengthening these efforts over time.

In November 2015, Canada announced an historic \$2.65 billion contribution over five years to help developing countries tackle climate change, in support of commitments made during the 2009 meeting of the UNFCCC in Copenhagen. This sum includes \$35 million to help reduce SLCP emissions, including emissions of black carbon and methane, to be used for (amongst other things) a \$10 million contribution to the Climate and Clean Air Coalition Trust Fund, and \$14 million to support NDC implementation through the deployment of clean technologies to reduce methane emissions in the Mexican oil and gas sector and in the Chilean waste management sector.

Canada-Mexico Partnership

ECCC and Natural Resources Canada (NRCan) have committed to support the government of Mexico in implementing its NDC for methane and black carbon emissions reduction. This bilateral collaboration between Canada and Mexico will specifically target reducing emissions from the oil and gas sector. Other objectives include technology and methodology innovation; technology demonstration for measurement, reporting and verification of baseline emissions and reductions; monitoring and evaluation of baseline emissions and reductions; investments in capital projects for emissions reduction; and implementation of a measurement and accounting system for methane and black carbon. Project activities will be managed by representatives from ECCC, NRCan, Mexico's National Institute for Ecology and Climate Change and Mexico's Secretariat of Environment and Natural Resources.

Canada-China Clean Technology Working Group

In 2016, Prime Minister Trudeau and President Xi Jinping agreed to cooperate on environmental protection and climate change. Canada will collaborate with the Chinese government, industry, and private sector partners to demonstrate and verify technologies and practices for the detection, quantification, and reduction of volatile organic compounds (VOC), methane, and PM_{2.5} (black carbon) emissions in the upstream and downstream oil and gas sector.

During his visit to China in December 2017, Prime Minister Trudeau and President Xi Jinping issued a Joint Statement on Climate Change and Clean Growth, highlighting the ongoing bilateral collaboration between Canada and China. The Joint Statement affirms the need to take action on climate change, and the need to transition to a clean growth economy through decisive, collaborative and cooperative response. Canada and China welcomed the announcement of the first Ministerial Dialogue on the Environment between ECCC and the Ministry of Environmental Protection of China. This Ministerial will allow for high-level engagement and cooperation of issues of mutual interest, including clean air, and will be aimed at achieving sustainable development to protect the health and well-being of the people and the environment of both countries.

World Bank Zero Routine Flaring by 2030 initiative

The “Zero Routine Flaring by 2030” initiative, introduced by the World Bank, brings together governments, oil companies, and development institutions who agree to cooperate to eliminate routine flaring that contributes to climate change and impacts the environment through emission of carbon dioxide, black carbon and other pollutants. In the interest of achieving zero routine flaring by 2030, Canada will work with the provinces and territories to implement consistent regulatory requirements to continue efforts towards eliminating routine flaring, recognizing that flaring for certain specific circumstances, such as safety or emergency reasons, may still need to occur. A number of Canadian regulators in provinces across the country have already taken action to eliminate routine flaring. These measures will ultimately reduce emissions of black carbon, CO₂ and other pollutants.

Chapter 5: Projects Relevant for the Arctic

Highlights of Canadian Climate Research Activities Relevant for the Arctic

Arctic Policy Framework

Canada is currently co-developing a new Arctic Policy Framework to advance federal interests, both domestically and internationally, which will guide actions, including research and monitoring, in the North until 2030. In addition to federal government representatives, partners in co-development of this framework include representatives from the territorial governments (Northwest Territories, Nunavut and Yukon), several provincial governments (Manitoba, Newfoundland and Labrador, and Quebec), as well as the Assembly of First Nations and Inuit Tapiriit Kanatami. Additional engagement with local Inuit, First Nations and Metis organizations and Northern stakeholders – including industry, academia, non-government organizations – is central to the development process. The completed Framework, which is expected to be announced in 2018, will lay out Canada's approach to supporting strong Arctic communities, protecting the environment and conserving Arctic biodiversity, advancing Arctic science and Indigenous Knowledge, and engaging in international arctic policy and communications. This Framework will better align Canada's national and international policy objectives with the priorities of Northerners. The new Framework will provide overarching direction to the Government of Canada's priorities, activities, and investments in the Arctic, with a horizon of 2030.

Research at Environment and Climate Change Canada

For more than a decade, ECCC has devoted significant effort in research and monitoring related to black carbon, methane, and other short-lived climate pollutants. Black carbon, as a component of $PM_{2.5}$, is monitored at the Canadian Aerosol Baseline Monitoring Program (CABM), which provides data on the physical, chemical and optical properties of aerosols that are required to understand the impact of black carbon on the climate system. Black carbon is also monitored in urban areas via the measurement of $PM_{2.5}$ by the National Air Pollution Surveillance Program (NAPS).

ECCC has an observational network for GHGs, including methane, located in coastal, interior and Arctic regions in Canada. The geographic distribution of these monitoring sites allows the spatial as well as the temporal trends in ambient methane concentrations to be examined. This information is important to support modelling activities, satellite remote sensing and policy development, and has enabled a variety of targeted research projects in Canada, and internationally.

For instance, atmospheric observations can be analyzed and interpreted using statistical methods, to determine regional source influences on atmospheric concentrations of methane. This allows for the identification of methane emission hot spots, which can then be correlated with areas with extensive oil and gas activity. At the same time, researchers from ECCC in association with researchers from Harvard, used National GHG Inventory data to develop maps showing the annual and monthly anthropogenic methane emissions across North America. Two significant studies that have occurred during the past few years include an aircraft-based measurement project in the Alberta oil sands region and a mobile-laboratory based measurement project in the southern Saskatchewan Bakken region. Both studies

focused on characterization of regional-scale emissions of pollutants, including black carbon and methane, for comparison to inventories and for understanding the transport and fate of the pollutants. A significant follow on aircraft-based measurement study is being planned for 2018.

Observing atmospheric gases from space-based instruments is an emerging area of research. ECCC has developed an algorithm to allow for the estimation of ammonia concentrations from space. This information, in conjunction with other data sources, will be used to improve understanding of methane emissions from animal feedlots.

ECCC also performs atmospheric modelling activities. For instance, ECCC has an operational air quality forecasting system for modelling wildfire contributions to black carbon loadings. A newly developed Carbon Assimilation System uses greenhouse gas observations from a variety of platforms (ground-based, aircraft, and satellite) and ECCC's operational weather forecast model to estimate the magnitude of GHG sources and sinks across Canada. Work is underway to introduce a tropospheric chemistry scheme into the Canadian Earth System Model to improve interactive modelling of methane, as well as improved representation of aerosols. Ongoing research to improve understanding and quantification of transportation sector emissions of methane will also allow improvement of ECCC products and the evaluation of impacts of potential mitigation options.

Polar Knowledge Canada's Science and Technology Program

Polar Knowledge Canada (POLAR) is responsible for advancing Canada's knowledge of the Arctic, and for strengthening Canadian leadership in polar science and technology. POLAR's pan-northern Science and Technology Program (2014-2019) consists of four priorities: baseline information to prepare for northern sustainability; predicting the impacts of changing ice, permafrost, and snow on shipping, infrastructure and communities; catalyzing improved design, construction, and maintenance of northern built infrastructure; and alternative and renewable energy for the North. Under the alternative and renewable energy priority to date, to help communities transition from diesel power to renewable energy, POLAR has supported projects relating to biomass heating, wind energy and solar energy in several communities across the North. A competitive funding call announced in 2016 provided funding to ten additional projects targeting clean energy and infrastructure for the North. POLAR is also leading by example; the Canadian High Arctic Research Station (CHARS) campus in Cambridge Bay features bike racks, low-flow fixtures, ongoing monitoring of building systems, testing of innovative wastewater and waste management technologies, a solar photovoltaic system, solar and wind monitoring, and a highly energy-efficient construction design. The facility also features common areas open to the public, to facilitate the exchange of scientific and traditional knowledge between scientists, researchers and other community members.

Research at Canadian Universities

Researchers from universities across Canada are providing world-class studies and assessments relevant to emissions and impacts of black carbon and methane in the Arctic. There is currently a strong interest among Canadian researchers as to the impact of increased ship traffic in the Northwest Passage as seasonal sea ice cover diminishes. The probable increase in ship traffic is likely to bring with it increases

in air pollutant emissions, as well as increased chances of accidental pollutant discharges (such as oil spills), and increased tourism. Research to understand and anticipate the environmental, political and social changes that will accompany this increased shipping are therefore of interest. The Arctic Marine Activities Integration and Synthesis Project (AMAI, also called the Arctic Corridors Project), hosted at the University of Ottawa, is one project aiming to enhance ocean governance through the Northern Marine Transportation Corridors. This project has established the first longitudinal database of ship traffic in Arctic Canada, enabling analysis of the changing patterns of ship traffic over time. The project also included community case studies to identify major risks and opportunities of increased shipping activity.

Another active area of SLCP research in the Arctic is understanding and quantifying carbon emissions in the form of CO₂ and methane as permafrost thaws. The warming Arctic climate is increasingly impacting the ground thermal regime in the North - permafrost (ground which remains below zero degrees Celsius for two or more years consecutively) is also warming progressively. As the ground warms, the active layer (the seasonally frozen ground above the permafrost, which thaws annually during the warmer summer months) is becoming deeper, and ground that was once frozen permanently is becoming susceptible to seasonal thaw. These changes are complex, and thaw is not occurring uniformly across the Arctic. This thaw allows organic matter once frozen in the ground to decompose and release greenhouse gases (carbon dioxide and methane) into the atmosphere. This release of greenhouse gases exacerbates climate change. Better understanding and quantifying this process is important to understanding the pace and magnitude of future Arctic change. Researchers from several academic and government institutions across Canada are performing research to better understand the rate of permafrost thaw across the Arctic, the processes occurring within the permafrost affecting the release of either methane or carbon dioxide, and the seasonal, diurnal, and long-term exchange of gases between the permafrost and the atmosphere. This improved carbon and terrestrial process understanding is being integrated in ECCC's climate models.

The NSERC FlareNet Strategic Network includes diverse group of researchers from several universities across Canada whose objectives are to provide a quantitative understanding of flare-generated pollutant emissions critical to enabling science-based regulations, accurate pollutant inventories, understandings of climate forcing and health implications, and engineered mitigation strategies to minimize environmental impacts in the energy sector. One of the main research themes is aimed at investigating the properties of black carbon with key goals of determining morphological and compositional characteristics as a function of flare conditions, measure optical properties of emitted black carbon and identify which black carbon characteristics will have the largest potential impact on climate and health, and (in concert with experiments in other themes) enable development of speciated emission factors for total particulate mass, black carbon particle mass, and organic carbon particle mass.

Solid Waste Management in Small Arctic Communities

In the Canadian Arctic, open dumping has been the leading means of managing household waste, despite the many hazards this presents – pollutant runoff into lakes and streams, litter making its way into the marine environment, and decomposition of organic material producing methane, and causing

fire, explosions and climate warming. To begin to address the current issues surrounding waste management in Arctic communities, Canada, Finland and the Aleut International Association are jointly putting forward a project to the Sustainable Development Working Group and the Arctic Contaminants Action Program of the Arctic Council. The project will produce a report on solid waste issues and best practices, designed to be useful for small Arctic communities. Ideas explored in this report will include an examination of best practices in solid waste management among the Arctic States, assessment of the potential for recycling/ reusing plans to lower waste and provide revenue, examination of waste management education and awareness programs, and an assessment of contaminants issues related to solid waste in the Arctic.

In March 2017, Environment and Climate Change Canada published a voluntary guidance document entitled [Solid Waste Management for Northern and Remote Communities](#). The document provides best practices for the planning, design, operation, and closure of existing or new municipal solid waste facilities in northern and remote regions. Developed with input from territorial government representatives, key stakeholders, and subject matter experts, the document is intended for regulators, infrastructure departments, senior administrative officers, band managers, facility operators, and other decision-makers in northern and remote regions.

Highlights of Canadian Assessments Relevant for the Arctic

Canada has been involved in domestic and international work related to assessments to improve the understanding of climate change and SLCPs. Multiple federal government departments and agencies are engaged in work and activities spanning a wide range of topics. The 2017 Black Carbon Inventory, described in Chapter 1, and the National Inventory Report on Greenhouse Gas Sources and Sinks and described in part in Chapter 2, are excellent examples of Canadian assessments relevant for the Arctic that contribute to international work. Additionally, the web-based [State of the Air Report](#), released by the Canadian Council of Ministers of the Environment (CCME) in November 2017 provides information on the state of the air quality in Canada, the sources of air pollutants, and the impacts of air pollutants on health and the environment.

In addition, Canadian scientists are active contributors to international publications reporting on the state of the Arctic and on current understanding of climate change. Canadian scientists were important contributors to Arctic Monitoring and Assessment Programme (AMAP) reports, including the [Snow Water Ice and Permafrost](#) report, the [Chemicals of Emerging Arctic Concern Report](#), and the [Influence of Climate Change on Transport Levels, and the Effects of Contaminants in Northern Areas – Part 2](#) report released in 2016 and 2017. Canada continues to be active in the production of AMAP reports, including the upcoming 2019 interim report on SLCPs and the 2021 scientific assessment. Similarly, Canadian scientists have contributed to past Assessment Reports produced by the Intergovernmental Panel on Climate Change (IPCC). Canadian scientists are actively contributing to Sixth IPCC Assessment Report, currently in production, and scheduled for release in 2022, as well as the IPCC Special Reports on Global Warming of 1.5°C; Ocean and Cryosphere in a Changing Climate; and Climate Change and Land.

Canada-specific assessments have also been released recently, or are planned for release in the near future. In the past, Polar Knowledge Canada (formerly the Canadian Polar Commission) has released

summary reports providing overviews of monitoring activities and key knowledge gaps relevant to the Canadian North: the 2014 [State of Northern Knowledge in Canada Report](#) provides an analysis of recurring and inter-related issues and research priorities of Northerners, while the 2015 [State of Environmental Monitoring in Northern Canada](#) provides the fundamental background to support decision regarding investment in new monitoring sites, and re-deployment and expansion of existing sites to achieve increased coverage of key parameters in priority areas.

Appendix A: List of Canada’s Federal and Provincial Measures that Reduce Emissions of Black Carbon

| Existing measures | New measures | Planned Measures |
|---|---|--|
| Transportation and Mobile Equipment | | |
| <ul style="list-style-type: none"> On-Road Vehicle and Engine Emission Regulations Off-Road Compression-Ignition Engine Emission Regulations Off-Road Small Spark-Ignition Engine Emission Regulations Sulphur in Diesel Fuel Regulations Marine Spark-Ignition Engine, Vessel and Off-Road Recreational Vehicle Emission Regulations Railway Safety Act SmartWay Transport Partnership Sustainable Transportation Strategy (Nova Scotia) Drive Clean (Ontario) Electric Vehicle Incentive program (Ontario) Drive Electric Program (Quebec) | <ul style="list-style-type: none"> Amendments to On-Road Vehicle and Engine Emission Regulations Draft Emissions Regulations for the Rail Sector Joined the International Zero Emission Vehicle Alliance (British Columbia and Quebec) Transportation Electrification Action Plan (Quebec) Developing and testing battery-electric transit buses and charging infrastructure The Big Move: Transforming Transportation in the Greater Toronto and Hamilton Area (Ontario) GreenTRiP (Alberta) Eccocamionnage program (Quebec) | <ul style="list-style-type: none"> Proposed Off-Road Compression Ignition and Large Spark-Ignition Engines Emission Regulations Proposed Regulations Amending the Off-Road Small Spark-Ignition Engine Emissions Regulations Proposed Regulations Amending the Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations Proposed Clean Fuel Standard Commitment to implement increasingly stringent emissions for light-duty vehicles Development of a Canada-wide strategy to promote the deployment of zero-emission vehicles Investments in public-transit upgrades |
| Commercial/Residential/Institutional | | |
| <ul style="list-style-type: none"> CCME Code of Practice for Residential Wood Burning Appliances CCME Model Municipal By-law for Regulating Wood Burning Appliances Guideline for operating wood-burning appliances (Nunavut) Northwest Territories Biomass Energy Strategy Yukon Good Energy Program Measures to control emissions from wood-burning appliances in provinces and municipalities across Canada, including regulatory measures (emissions standards, certification requirements, operation and maintenance requirements, no burn days/advisories, prohibition of wood burning appliances, and wood burning by-laws) and non-regulatory measures | <ul style="list-style-type: none"> CCME Guidance Document for Open Air Burning Wood stove change out program in Nova Scotia, Ontario, New Brunswick and British Columbia British Columbia Solid Fuel Burning Appliance Regulations Yukon Biomass Energy Strategy | |

| | | |
|---|--|--|
| <p>(model ordinances, change-out programs, financial incentives and outreach programs).</p> <ul style="list-style-type: none"> • By-laws and other instruments in provinces, territories and municipalities across Canada related to open air burning | | |
| Ore and Mineral Industries | | |
| <ul style="list-style-type: none"> • Secondary Lead Smelter Release Regulation • Code of Practice for Base Metals Smelters and Refineries • Code of Practice for Integrated Steel Mills • Code of Practice for Non-Integrated Steel Mills • Pollution Prevention Notice for Base Metals Smelters and Refineries and Zinc Plants • Regulations for Iron Ore Mining Sector (Newfoundland) | <ul style="list-style-type: none"> • Code of Practice to Reduce Emissions of Fine Particulate Matter (PM2.5) from the Aluminium Sector • Code of Practice to Reduce Fugitive emissions of Total Particulate Matter and Volatile Organic Compounds from the Iron, Steel and Ilmenite Sector • Code of Practice for the Management of Fine Particulate matter Emissions in the Potash Sector in Canada • Commitments for Base Metal Smelters (Ontario) | |
| Oil and Gas Industry | | |
| <ul style="list-style-type: none"> • Natural Resources Canada research and technology development roadmap to address wellbore leakage • Regulatory measures and financial incentives to reduce venting and flaring (Alberta, Saskatchewan and British Columbia) • Oil and Gas Commission Flaring Venting and Reduction Guideline (British Columbia) • Eliminated associated gas flaring in 2010 (British Columbia) • Revenue neutral carbon tax applied to flared gas (British Columbia) | | <ul style="list-style-type: none"> • Standards for development of projects, including mandatory leak detection and repair (British Columbia) • Proposed development of requirements for new facilities and voluntary initiatives aimed at reducing venting and fugitive emissions from existing facilities (Alberta) |
| Electric Power Generation | | |
| <ul style="list-style-type: none"> • Reduction of Carbon Dioxide Emissions from Coal-Fired Generation of Electricity Regulations • Pan-Canadian Task Force to reduce the use of diesel fuel to generate electricity in remote communities • New Source Emission | <ul style="list-style-type: none"> • Aim to generate 50% of electricity using renewable energy by 2030 (Saskatchewan) • Lower Churchill hydroelectricity project (Newfoundland and Labrador) | <ul style="list-style-type: none"> • Proposed Regulations Amending the Reduction of Carbon Dioxide Emissions from Coal-Fired Generation of Electricity Regulations • Federal investments to help reduce reliance on diesel for electricity and heating in northern, remote and |

| | | |
|--|--|---|
| <p>Guidelines for Thermal Electricity Generation</p> <ul style="list-style-type: none"> • Renewable Portfolio Standard (Prince Edward Island) • Ending Coal for Cleaner Air Act (Ontario) • Various regulations (Nova Scotia) • Emissions tax on coal (Manitoba) • Ban on use of coal as space-heating fuel (Manitoba) • Alberta Air Emission Standards for Electricity Generation | | <p>Indigenous communities</p> <ul style="list-style-type: none"> • Phase out coal-fired electricity by 2030 (Alberta) • Regulatory framework to transition from coal to clean electricity (Nova Scotia) |
| Other | | |
| <ul style="list-style-type: none"> • Canadian Ambient Air Quality Standard for PM_{2.5} • Sustainable Development Technology Canada funding program | <ul style="list-style-type: none"> • Pan-Canadian Framework on Clean Growth and Climate Change • ECCC Strategy on Short-Lived Climate Pollutants • Canadian Ambient Air Quality Standards for PM_{2.5} are reviewed in 2017 • Quebec Clean Air Regulations updated in 2017 | |

Appendix B: List of Canada's Federal and Provincial Methane Mitigation Measures

| Existing measures | New measures | Planned Measures |
|---|--|--|
| Oil and Natural Gas - Fugitives, Venting and Flaring | | |
| <ul style="list-style-type: none"> Natural Resources Canada research and technology development roadmap to address wellbore leakage Regulatory measures and financial incentives to reduce venting and flaring (Alberta, Saskatchewan and British Columbia) Oil and Gas Commission Flaring Venting and Reduction Guideline (British Columbia) Eliminated associated gas flaring in 2010 (British Columbia) Revenue neutral carbon tax applied to flared gas (British Columbia) | <ul style="list-style-type: none"> Commitment to reduce methane emissions from oil and gas sector by 40-45% below 2012 levels by 2020 Climate Leadership Plan, including a target to reduce methane emissions from new oil and gas extraction and processing by 45% by 2025 (British Columbia) Clean Infrastructure Royalty Credit Program (British Columbia) Goal to cut methane emissions by 45% from oil and gas by 2025 (Alberta) | <ul style="list-style-type: none"> Proposed Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector) Standards for development of projects, including mandatory leak detection and repair (British Columbia) Proposed development of requirements for new facilities and voluntary initiatives aimed at reducing venting and fugitive emissions from existing facilities (Alberta) |
| Agriculture | | |
| <ul style="list-style-type: none"> Growing Forward 2 Agricultural Greenhouse Gases Program Prime-Vert (Quebec) | <ul style="list-style-type: none"> Food additives in livestock production to reduce methane emissions (Prince Edward Island) | <ul style="list-style-type: none"> Canadian Agricultural Partnership to be launched in 2018 |
| Waste | | |
| <ul style="list-style-type: none"> Gas Tax Fund Green Infrastructure Fund Green Municipal Fund ecoENERGY for Renewable Power EcoAction Community Funding Program Technical Document on Municipal Solid Waste Organics Processing Ecology North Provincial and municipal recycling programs Solid Waste Resource Management Regulations (Nova Scotia) Specified Gas Emitters Regulation (Alberta) Prescribed Landfills Regulation (Manitoba) Landfilling Sites Regulation (Ontario) Landfill Gas Management | <ul style="list-style-type: none"> Commitment to reduce food waste in Canada by 50% Consultations on strategies to reduce avoidable food waste, increase organics diversion, and increase recycling and reuse Solid Waste Management for Northern and Remote Communities, a voluntary guidance document that provides best practices for the planning, design, operation, and closure of existing or new municipal solid waste facilities in northern and remote regions. | <ul style="list-style-type: none"> Development of a national food policy |

| | | |
|---|--|---|
| Regulation (British Columbia) | | |
| Other | | |
| <ul style="list-style-type: none"> • Sustainable Development Technology Canada funding program | <ul style="list-style-type: none"> • Pan-Canadian Framework on Clean Growth and Climate Change • ECCC Strategy on Short-Lived Climate Pollutants • Climate Change Action Plan Progress Report (Yukon) • Climate Change and Green Economy Plan (Manitoba) • Climate Leadership Plan (Alberta) • Climate Change Strategy (Ontario) | <ul style="list-style-type: none"> • Develop and implement a national methane reduction strategy |

Appendix C: Measures reflected in Greenhouse Gas Projections

| Provincial/Territorial Measures | Federal Measures |
|--|---|
| Adoption of the National Energy Code for Buildings of Canada (2010-2012) by all provinces and territories | <ul style="list-style-type: none"> Reduction of carbon dioxide emissions from coal-fired generation of electricity regulations announced in 2012 |
| Renewable Fuel Content across all provinces and territories (except for Newfoundland and Labrador, Yukon, the Northwest Territories and Nunavut) | <ul style="list-style-type: none"> Federal Budget 2016: Supporting Energy Efficiency and Renewable Energy Development. Increase efficiency of residential and commercial devices (including refrigeration, freezers, ranges, dryers) through regulations and ENERGY STAR certification (Amendment 14) |
| Newfoundland <ul style="list-style-type: none"> Muskkrat Falls hydro project | <ul style="list-style-type: none"> Equipment Standards (Amendment 13) Voluntary emission reductions for planes and trains |
| Nova Scotia <ul style="list-style-type: none"> Cap on GHG emissions from the electricity sector Renewable portfolio standard for electricity generation Electricity demand-side management policies Solid Waste-Resource Management Regulations | <ul style="list-style-type: none"> Light-duty vehicles 1 (LDV-1) GHG emissions standards for the light-duty vehicle model years 2011 to 2016 |
| New Brunswick <ul style="list-style-type: none"> Renewable Portfolio Standard | <ul style="list-style-type: none"> Light-duty vehicles 2 (LDV-2) GHG emissions standards increases stringency for model years 2017 to 2025 |
| Quebec <ul style="list-style-type: none"> Western Climate Initiative cap-and-trade regime 5% ethanol objective in gasoline distributors fuel sales Drive electric program Landfill gas regulation Eco-performance program for industry Program to support energy efficiency improvements in marine, air and rail transport (PETMAF) Program to reduce/avoid GHG emissions by using intermodal transportation (PREGTI) Program Écocamionnage | <ul style="list-style-type: none"> Heavy-duty vehicles 1 (HDV) GHG emissions standards for heavy-duty vehicle model years 2014 to 2018 Heavy-duty vehicles 2 (HDV) GHG emissions standards for heavy-duty vehicle model years 2021 to 2027 and trailers Regulations Amending the Ozone-depleting Substances and Halocarbon Alternatives Regulations Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector) |
| Ontario <ul style="list-style-type: none"> Western Climate Initiative cap-and-trade regime Residential electricity peak savings (time-of-use pricing) Feed-in tariff program Landfill gas regulation (O. Reg. 216/08 and 217/08) Strategy for a Waste-free Ontario Independent Electricity System Operator contracted electricity supply Nuclear refurbishment Energy Storage Contract with Quebec Ontario Natural Gas 2015-2020 Conservation Framework Ontario Electricity 2015-2020 Conservation Framework Ontario Electric Vehicle Chargers Ontario, Electric Vehicles Incentive Program (EVIP) and Electric and Hydrogen Vehicles Advancement Partnership (EHVAP) | |
| Manitoba <ul style="list-style-type: none"> Emissions tax on coal | |

| Provincial/Territorial Measures | Federal Measures |
|--|------------------|
| <ul style="list-style-type: none"> • Manitoba Building Code Section 9.36 (for housing) • Manitoba Composts program | |
| <p>Saskatchewan</p> <ul style="list-style-type: none"> • Boundary Dam 3 Carbon Capture Project • Uniform Building and Accessibility Standards Regulations (2013) | |
| <p>Alberta</p> <ul style="list-style-type: none"> • Specified Gas Emitters Regulations transitioning to the Emissions Performance Standards in 2018 • Carbon levy • Coal Phase-Out by end of 2030 • 100 Mt cap for oil sands • Renewable Electricity Program • Quest carbon capture and storage project • Carbon Trunk Line Project – CO2 capture and use for enhanced oil recovery • Energy efficiency requirements for housing and small buildings, section 9.36 of the 2014 Alberta Building Code edition • Municipal Waste Annual Disposal Targets | |
| <p>British Columbia</p> <ul style="list-style-type: none"> • Carbon tax increasing to \$35 in 2018, \$40 in 2019, \$45 by 2020 and \$50 in 2021 • British Columbia Cement Low Carbon Fuel Program • Renewable and Low Carbon Fuel Requirements Regulation (10% reduction in CI by 2020) • Landfill gas management regulation • British Columbia Clean Energy Act: Clean or renewable electricity requirement – 100% of electricity from clean or renewable sources by 2025 • Revisions for energy efficiency of large residential and commercial buildings (Part 3) (reg # 167/2013) • Revisions for energy efficiency of housing and small buildings (Part 9) (reg # 173/2013) • City of Vancouver Building Codes • Clean Energy Vehicles Program (Phase 1, 2, Phase 3 and Beyond) and support for zero emissions vehicle charging stations in buildings • Step Code: Increased Energy Efficiency Requirements in the Building Code • Municipal Waste disposal target and organic waste disposal restriction | |
| <p>Northwest Territories</p> <ul style="list-style-type: none"> • Biomass Strategy | |