CANADA'S NATIONAL REPORT ON BLACK CARBON AND METHANE

Canada's Third Biennial Report to the Arctic Council







Environment and

Canada's National Report on Black Carbon and Methane: Canada's Third Biennial Report to the Arctic Council

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1. Introduction

Canada is pleased to provide its third biennial National Report on Black Carbon and Methane. This report summarizes emissions trends and projections for black carbon and methane, and outlines Canada's current and planned actions to reduce emissions. Submission of this report to the Arctic Council satisfies a biennial commitment made under the Framework for Action on Enhanced Black Carbon and Methane Emissions Reductions (the Framework), agreed to by Arctic states in 2015 during the Canadian chairmanship of the Arctic Council.

The Framework provides guidance on the content of the national report that each Arctic State, and participating Arctic Council Observers, are required to submit to the Arctic Council Secretariat every two years. This includes:

- A summary of the 2017 emissions data on black carbon submitted under the Convention on Long Range Transboundary Air Pollution (LRTAP), and, if available, future projections
- Summary of the most recent methane emissions submitted to the United Nations Framework Convention on Climate Change (UNFCCC) and, if available, future projections
- 3. Summary of national actions, national action plans, or mitigation strategies by sector
- 4. Highlights of best practices or lessons learned for key sectors
- 5. Information on projects relevant for the Arctic
- 6. Other information if available (e.g., climate, health, environmental, and economic effects of black carbon and methane emissions and mitigation efforts)

Canada submitted biennial reports to the Arctic Council in 2015 and 2017. In this report, emission estimates and projections of black carbon are outlined in Chapter 2, followed by methane emissions and projections in Chapter 3. Chapter 4 provides a summary of current Canadian actions to address black carbon and methane. Sector-specific initiatives are highlighted in Chapter 5, followed by a summary of international engagement efforts in Chapter 6. Annex 1 links more detailed Canadian actions to specific recommendations made by the Arctic Council Expert Group on Black Carbon and Methane (EGBCM) in its 2019 Summary of Progress and Recommendations report.

Addressing emissions of black carbon and methane is a priority for Canada. Taking action to reduce these and other short-lived climate pollutants is an important component of Canada's plan to mitigate climate change, in support of the Paris Agreement goal to limit global average temperature rise to below 2°C, and pursue efforts to limit the increase to 1.5°C. Reducing emissions will also allow Canada to achieve human health and economic benefits. Domestic and international actions, as outlined in this report, will help deliver on the Government of Canada's commitment to fight climate change, ensure clean air for all Canadians, and grow the economy.

2. Black Carbon Emissions

Canada produces emission estimates of black carbon on an annual basis. The 2019 edition of Canada's Black Carbon Emissions Inventory Report (Environment and Climate Change Canada, 2019b) outlines black carbon emissions from anthropogenic sources for 2013 to 2017. Emissions data and Canada's official Black Carbon Inventory are available on <u>Canada.ca</u>.

Canada also produces projections for black carbon emissions annually. The most recent black carbon projections data are published in Canada's Fourth Biennial Report to the United Nations Framework Convention on Climate Change (UNFCCC). (Environment and Climate Change Canada, 2019c). Data on projected emissions are available for download through the <u>Open</u> <u>Data Portal</u>.

Black carbon emission estimates are based on estimates of fine particulate matter ($PM_{2.5}$) compiled annually for <u>Canada's Air Pollutant Emissions Inventory</u> (Environment and Climate Change Canada, 2019a). $PM_{2.5}$ estimates from combustion-related sources are multiplied by source-specific ratios to estimate the component of overall $PM_{2.5}$ that is black carbon for those sources.

Canada submits its black carbon inventory to the Arctic Council as per its commitment to do so under the Arctic Council Framework for Action on Enhanced Black Carbon and Methane Emissions Reductions. Since 2015, Canada has also submitted its national emissions inventory for black carbon on an annual basis to the United Nations Economic Commission for Europe's Convention on Long-range Transboundary Air Pollution. Black carbon, as a component of particulate matter, was added to the Convention's Gothenburg Protocol when it was amended in 2012. In addition to voluntary reporting on black carbon emissions, the amended Protocol calls for countries to prioritize PM_{2.5} reductions from sources that are also significant sources of black carbon emissions. Canada ratified the Gothenburg Protocol in 2017 and it entered into force in October 2019. Submission of Canada's Black Carbon Emissions Inventory also helps track progress towards the collective and aspirational goal committed to by Arctic States in 2017 to reduce black carbon emissions by 25-33% from 2013 levels by 2025.

Black Carbon Emission Trends and Projections

In 2017, approximately 36 kilotonnes (kt) of black carbon were emitted from anthropogenic activities in Canada. The largest contributing sectors to overall black carbon emissions were onand off-road diesel engines with 38% of emissions (14 kt), followed by home firewood burning with 32% (12 kt) of emissions. Other sources of emissions included marine and rail transportation with 8% (2.8 kt) and 4% (1.4 kt) of emissions, respectively, and flaring in the upstream oil and gas industry with 4% (1.4 kt) of emissions. All other sources accounted for the remaining 15% (5.6 kt) of emissions from anthropogenic activities. (Figure 2-1).



Figure 2-1: Canada's 2017 black carbon emissions, by largest contributing sectors^{1,2}

Canada's Black Carbon Emissions Inventory tracks estimated annual emissions of black carbon from 2013 onwards. In 2017, emissions were 18% (8.0 kt) below the estimated levels for 2013 (Figure 2-2). The decrease is largely due to reductions in emissions from off-road diesel engines, as well as a reduction in emissions from marine transportation. Lower emissions from on-road diesel engines also contributed to the decreasing trend. Emissions from home firewood burning, rail transportation, upstream oil and gas flaring and other sectors remained relatively stable from 2013 to 2017.

¹ Data downloaded from Canada's Open Data Portal: https://open.canada.ca/data/en/dataset/d00dd235d194-4932-9ec0-45011d2bd347

² Note that totals may not add up to 100% due to rounding



Figure 2-2: Canada's black carbon emissions trends (2013-2017)³

Canada's emissions of black carbon are projected to continue decreasing to 2030. Two emissions projection scenarios are presented in Figure 2-3; *Current Measures*⁴, and *Additional Measures*⁵. Projections for *Current Measures* represent expected emissions of black carbon under policies and measures that are in place as of September 2019. Projections for *Additional Measures* represent expected emissions of black carbon under those same policies and measures that have been announced but are not yet in place. Under the *Current Measures* scenario, black carbon emissions are expected to decrease by 16% (6 kt) by 2030 relative to 2017 emissions, for a total of 30 kt emitted in 2030. Under the *Additional Measures* scenario, black carbon emissions are expected to decrease by 25% (9 kt) by 2030 compared to 2017 emissions, for a projected total of 27 kt in 2030.

Canada is on track to do its part to achieve the collective goal of Arctic States to reduce emissions of black carbon by 25-33% from 2013 levels by 2025. National black carbon emissions are projected to have decreased by 29% (13kt) from 2013 emissions by 2025 under

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

³ Trends data downloaded from Canada's Open Data Portal:

⁴ *Current Measures* is often referred to as "Reference Case" in technical projections documents ⁵ *Additional Measures* is often referred to "Reference Case with Additional Measures" in technical documents.

the *Current Measures* projection scenario, and by 34% (15 kt) from 2013 emissions by 2025 under the *Additional Measures* projection scenario. Total collective emissions from all Arctic Council member states are compiled and presented in the Expert Group on Black Carbon and Methane's *Summary of Progress and Recommendations* series of reports which are produced on a two-year cycle.



Figure 2-3: Canada's black carbon emissions projections (2018-2030)⁶

3. Methane Emissions

Canada submits national inventories of anthropogenic emissions of methane and other greenhouse gases to the United Nations Framework Convention on Climate Change (UNFCCC) on or before April 15th each year. This submission consists of the National Inventory Report (Environment and Climate Change Canada, 2019d), as well as Common Reporting Format (CRF) tables, published on the <u>UNFCCC's website</u>. Additionally, the data are available through Canada's Open Data Portal.

Canada also publishes greenhouse gas projections on an annual basis. The most recent methane projections data are published in Canada's Fourth Biennial Report to the United

⁶ Projections data can be downloaded from Canada's Open Data Portal: <u>https://open.canada.ca/en/open-data</u>

Nations Framework Convention on Climate Change (UNFCCC) (Environment and Climate Change Canada, 2019c). Data are available through Canada's <u>Open Data Portal</u>.

Methane Trends and Projections

In 2017, an estimated 3700 kt of methane were emitted from anthropogenic sources in Canada, accounting for 13% of Canada's total greenhouse gas emissions. The largest contributing sector to methane emissions is the oil and gas industry, through both fugitive emissions (leaks or other unintended losses of methane) from the production of oil and gas (18% of total methane emissions in 2017), and venting and flaring activity in oil and gas production (23% of methane emissions) (see Figure 3-1)⁷. Within the agricultural sector, livestock (enteric fermentation) are a major contributor to methane emissions, contributing 26% to the national total in 2017, while landfills contributed 18%. All other sources of methane collectively accounted for 15% of Canada's methane emissions from anthropogenic sources in 2017.



Figure 3-1: Canada's 2017 methane emissions, by largest contributing sectors^{8,9}

⁷ For the purposes of this report, "oil and gas fugitive" refers specifically to IPCC Common Reporting Format sector 1.A.B.2.a and 1.A.B.2.b, while "oil and gas venting and flaring" refers specifically to Common Reporting Format sector 1.A.B.2.c.

⁸ Data downloaded from Canada's Open Data Portal: <u>https://open.canada.ca/data/en/dataset/779c7bcf-4982-47eb-af1b-a33618a05e5b</u> (note that "Landfills" as presented in this report corresponds with "Solid Waste Disposal" in the National Inventory Report, and "Livestock" corresponds with "Enteric Fermentation")

⁹ Note that totals may not add up to 100% due to rounding

Since 2005, Canada's methane emissions have decreased by an estimated 520 kt, or 12%. This trend is mostly due to decreases in emissions from livestock and from the oil and gas sector (Figure 3-2).



Figure 3-2: Canada's methane trends, 2005-2017¹⁰

As with black carbon, methane emissions projections are modelled under a *Current Measures* scenario, reflecting policies and measures in place as of September 2019, and an *Additional Measures* scenario, reflecting policies and measures that have been announced but have not yet been implemented. Emissions are projected to decrease from current levels under both scenarios, with a 13% decrease (524 kt) by 2030 relative to 2017 emissions under the *Current Measures* scenario, and a 14% (575 kt) decrease by 2030 relative to 2017 emissions under the *Additional Measures* scenario (Figure 3-3).

¹⁰ Trends data downloaded from Canada's Open Data Portal:

https://open.canada.ca/data/en/dataset/779c7bcf-4982-47eb-af1b-a33618a05e5b



Figure 3-3: Canada's methane emissions projections (2018-2030)¹¹

4. National Strategies and Action Plans

4.1 Governance

In Canada, protection of the environment is a shared responsibility between the federal, provincial, and territorial governments. At the federal level, Environment and Climate Change Canada is responsible for leading the response to a wide range of environmental concerns, including climate change and air pollution. In doing so, the department works closely with other federal departments, and consults with provincial and territorial governments, Indigenous organizations and other partners. Other federal departments that are directly or indirectly engaged in addressing black carbon and methane emissions include Agriculture and Agri-Food

¹¹ Projections data can be downloaded from Canada's Open Data Portal: <u>https://open.canada.ca/en/open-data</u>

Canada, Natural Resources Canada, Health Canada, Transport Canada, Infrastructure Canada, and Crown-Indigenous Relations and Northern Affairs Canada.

In addition to federal actions by the Government of Canada, a significant amount of action is taken at sub-national levels, through provincial and territorial climate change and air quality action plans, as well as municipal and regional governments and Indigenous communities. Some of these activities are profiled in this report; however, this document is not an exhaustive list of Canadian actions to reduce emissions of black carbon and methane.

The following sections focus on national strategies and action plans in Canada that directly or indirectly address emissions of black carbon and methane.

4.2 Canada's Strategy on Short-Lived Climate Pollutants

In 2017, Environment and Climate Change Canada released the <u>Strategy on Short-Lived</u> <u>Climate Pollutants</u> (SLCPs). The Strategy, which is complementary to the Pan-Canadian Framework on Clean Growth and Climate Change, was developed to guide future actions in reducing SLCPs, including black carbon and methane, as well as ground-level ozone and hydrofluorocarbons. The Strategy takes a holistic approach to addressing SLCPs through 48 commitments under five pillars for enhanced action: 1) domestic mitigation efforts; 2) science and communications; 3) international engagement; 4) coordination of ECCC and governmentwide activities; and 5) collaboration with provincial and territorial governments and other partners. The objective of the strategy is to generate reductions from all key SLCP emission sources while ensuring a coordinated approach across the Government of Canada for addressing SLCPs.

4.3 Pan-Canadian Framework

The **Pan-Canadian Framework on Clean Growth and Climate Change** (PCF), released in 2016, outlines Canada's plan to meet emission reductions targets under the Paris Agreement while growing the economy. The PCF was developed in close consultation with Canadians, businesses, non-governmental organizations, and Indigenous Peoples, and is based on four pillars: 1) pricing carbon pollution; 2) complementary measures to reduce emissions; 3) measures to adapt to the impacts of climate change and build resilience; and 4) actions to accelerate innovation, support clean technology, and create green jobs. Since 2016, the PCF has shifted from design and planning towards implementation and delivery. There are more than 50 actions under the PCF, covering all major sectors of the Canadian economy.

In December 2019, the Government of Canada announced commitments to strengthen existing measures and to introduce new greenhouse gas reducing measures in order to exceed Canada's current 2030 emissions reduction goal. In addition, Canada will develop a plan to achieve net-zero emissions by 2050.

The <u>Low Carbon Economy Fund</u> (LCEF) is an important part of the PCF. The \$2 billion fund was established to fund projects that will generate clean growth, reduce greenhouse gas emissions, and help meet or exceed Canada's Paris Agreement commitments. The fund is

divided into two components: the Low Carbon Economy Leadership Fund, and the Low Carbon Economy Challenge. The Leadership fund is providing \$1.4 billion to provinces and territories that have adopted the PCF to help them achieve emission reductions. The Challenge fund is providing over \$500 million to projects across the country, and is open to businesses, not-for-profit organizations, municipalities, Indigenous communities and organizations, and territories and provinces. Among the successful project applicants announced in 2019 are a number of projects that will achieve methane emission reductions, including landfill gas collection projects, as well as waste diversion, and biogas production projects.

The <u>Clean Fuel Standard</u> (CFS) is another important part of the PCF, which will set carbon intensity requirements for liquid, gaseous and solid fuels on a life-cycle basis, accounting for the amount of greenhouse gases produced per unit of energy generated. The expected influence of the CFS on emissions of black carbon and methane varies across sectors. In some sectors, the impact of the CFS on reducing emissions of methane is expected to be significant. For example, the CFS is expected to provide an incentive for the oil and gas industry to capture and utilize methane above and beyond what is mandated under provincial and federal regulations, rather than flaring or releasing those emissions to the atmosphere. Other actions that would be recognized under the CFS include capturing methane from landfills and converting it to low-carbon-intensity fuel.

The PCF includes many other components, some of which are outlined in Chapter 5: Strategies Targeting Main Sources of Emissions.

4.4 Canada's Air Quality Program

Canada's Air Quality Program is a multi-faceted approach to tackling air pollution. The program aims to improve the quality of Canada's air and to reduce emissions of harmful air pollutants, including SLCPs, so as to minimize their adverse effects on human health and the environment. As part of its work, the program supports objectives to track and reduce emissions of air pollutants, including black carbon from various sources, as well as reductions of other air pollutant emissions. Specific actions under this program are explained in more detail later in this document, including regulations on heavy-duty diesel engines and vehicles.

4.5 Arctic and Northern Policy Framework

<u>Canada's Arctic and Northern Policy Framework</u> (ANPF), released in 2019, provides a clear set of priorities and actions, through 2030, for the federal government to ensure a future where northern and Arctic people are thriving, strong and safe. The ANPF was co-developed with Indigenous, territorial, and provincial partners. The ANPF recognizes that Canada's Arctic and northern regions are already facing the impacts of climate change, and therefore climate change mitigation and adaptation are important parts of the framework. Goal 5 of the ANPF is to ensure that "Canadian Arctic and northern ecosystems are healthy and resilient". Specifically, Objective 1 of this goal is to "Accelerate and intensify national and international reductions of greenhouse gas emissions and short-lived climate pollutants". This includes a commitment to "support and

enhance international efforts through the Arctic Council, UN bodies and other forums to reduce emissions of short-lived climate pollutants, especially black carbon".

5. Strategies Targeting Main Sources of Emissions

This section of the report outlines relevant Canadian policies, regulations, strategies and programs that address emissions of black carbon and methane from major contributing sources. These initiatives are part of a suite of actions taken by Canada as part of the federal climate change and clean air agendas. Many of these actions correspond with recommendations made in in the Expert Group on Black Carbon and Methane's <u>2019 Summary of Progress and</u> <u>Recommendations</u> report (Arctic Council Expert Group on Black Carbon and Methane, 2019). Please refer to Annex 1 for a more complete list of Canadian actions that correspond with recommendations made in the Expert Group's 2019 report.

5.1 Mobile and Stationary Diesel-

Powered Sources

Mobile and stationary diesel-powered sources were identified by the Expert Group on Black Carbon and Methane as a key source of black carbon emissions that affect the Arctic. Emissions from on- and off-road diesel engines and marine transportation sectors accounted for 45% of Canada's estimated black carbon emissions in 2017.



New Diesel Engine Regulations

As part of Canada's Air Quality Program in 2019,

proposed Off-road Compression-Ignition (Mobile and Stationary) and Large Spark-Ignition Engine Emission Regulations were published, and will replace Canada's current Off-Road Compression-Ignition Engine Emission Regulations upon final publication. The proposed Regulations would introduce new emissions standards that align Canadian standards with corresponding U.S. standards. The proposed Regulations also include standards for off-road large spark-ignition and stationary compression-ignition engines that were not previously covered by federal regulations in Canada. This complements PCF efforts and federal programs aimed at reducing reliance on diesel, discussed below, by ensuring that, when new diesel engines cannot be avoided, efficient lower-emitting engines are installed. New efficient diesel engines will also play an important role in "hybrid" systems, an alternative to primary diesel generation. These hybrid systems combine wind or solar power, battery, or other energy storage technology, and back-up diesel generators. The proposed Regulations would limit

¹² Reference Figure 2-1 for complete details on black carbon emissions. The graph shown here is for illustrative purposes.

emissions of black carbon and other particulate matter, as well as nitrogen oxides, hydrocarbons, and carbon monoxide from mobile diesel engines used in transportation and other equipment, as well as stationary diesel engines generally used for electricity generation. Among other benefits, the Regulations are expected to reduce emissions of black carbon in Northern, remote and Indigenous communities and off-grid mines that currently rely on diesel for power generation, thus improving local air quality and reducing near-term local warming.

Reducing Reliance on Diesel

In Canada, there are approximately 200 northern, remote and Indigenous communities and offgrid industrial sites (e.g. mines) that rely on diesel generation for all or part of their electricity and heating needs (Figure 5-1). Diesel-generated electricity contributes to black carbon emissions and associated health and climate concerns. Diesel fuel transported long distances from southern Canada is also expensive—limiting the development of communities that rely on it.

In addition to the regulations limiting black carbon emissions from diesel power generation, Canada is also taking action to reduce the reliance of remote communities on diesel by

promoting and supporting their transition to more sustainable, clean energy technologies. In addition to health and environmental benefits, the installation of local sources of renewable energy (such as wind, solar, hydro or biomass) supports energy independence, and provides local economic development opportunities including skills development and job creation.



Figure 5-1: Remote communities in Canada that rely on diesel as their main power source (Natural Resources Canada, 2018)

As part of the Pan-Canadian Framework on Clean Growth and Climate Change, the \$220 million <u>Clean Energy for Rural and Remote Communities program</u> was launched in 2018 to reduce the reliance of rural and remote communities on diesel fuel for heat and power. The program, lead by Natural Resources Canada, awards funds to successful applicants for demonstration projects that reduce reliance on diesel in Canada's remote communities and at

remote industrial sites. As of winter 2019-2020, funding for successful projects was being finalized.

Impact Canada is a Government of Canada-wide initiative that provides departments with the opportunity to adopt innovative program approaches, such as prize-challenges, to address some of the biggest issues facing Canadians and their communities. Under this initiative, Natural Resources Canada was allocated \$75 million over four years to deliver a series of clean technology challenges to identify and deliver breakthrough solutions to persistent barriers in clean technology development and adoption, such as reducing reliance on diesel in northern and remote communities. The <u>Indigenous Off-Diesel Initiative</u>, launched by Natural Resources Canada in 2019, supports Indigenous clean energy champions and their communities with training, access to expertise and resources to develop and start implementing ambitious diesel reduction plans. The Initiative's Indigenous Jury selected 15 clean energy champions from across Canada who will receive up to \$1.3 million to develop and implement diesel reduction plans in their communities.

The Northern Responsible Energy Approach for Community Heat and Electricity Program

(Northern REACHE), led by Crown-Indigenous Relations and Northern Affairs Canada, funds renewable energy and efficiency projects in Canada's three territories as well as the Inuit regions of Nunavik (Northern Quebec) and Nunatsiavut (Northern Labrador). The program's primary objective is to support off-grid Indigenous and northern communities to reduce their reliance on diesel fuel for heat and electricity by promoting the use of local renewable energy sources including biomass, wind and solar, as well as through improved energy efficiency. Northern REACHE was established in 2016, and was recently allocated \$53.5 million over 10 years starting in 2018/2019. A wide range of applicants can submit project proposals seeking funding and expertise through the program, including municipalities, Indigenous organizations, territorial governments, First Nation and Inuit communities, and not-for-profit organizations. Recently selected projects include an energy coordinator position within the Nunatsiavut Government; the installation of solar panels on the Makkovik Arena in Labrador; and the installation of three, 100 kW wind turbines and 300 kWh of battery storage in the Kluane First Nation, Yukon.

Shipping in the Arctic

Canada supports the work of the International Maritime Organization (IMO) to reduce the impact of black carbon emissions from shipping on the Arctic. Canada recognizes the IMO as the global standard-setting authority for the safety, security and environmental performance of international shipping.

Marine Emissions Inventory Tool

The <u>Marine Emissions Inventory Tool</u> (MEIT) was released by Environment and Climate Change Canada in September 2019. MEIT provides an inventory of shipping activity, energy use, greenhouse gas emissions and air pollutants, including black carbon, from marine vessels. The interactive online tool allows users to generate emissions on maps, filter information by year, region or other conditions, generate emission reports, and view forecasts to 2050. This tool enables researchers, policy makers, industry and members of the public to analyze black carbon shipping emissions in different regions of the country to better understand current emissions sources and opportunities for reducing emissions.

Other Programs and Drivers

There are a number of other programs that are expected to support or enable further reductions in diesel use by promoting clean energy generation in communities that currently rely on diesel for electricity and heating. These include the Arctic Energy Fund, the Low Carbon Economy Fund, and the First Nation Infrastructure Fund.

In addition, the first phase of the Clean Fuel Standard will set carbon intensity requirements for liquid fossil fuel types, including diesel and home heating fuel. The regulatory design of this first phase is expected to incentivize the use, and increase the availability, of cleaner low-carbonintensity fuels and encourage a reduction in the use of diesel for transportation and energy generation.

Similarly, provincial regulatory and non-regulatory measures, including renewable fuel requirements for gasoline and diesel, and provincial renewable energy plans, are incentivizing the use of cleaner fuels.

Canada has set ambitious national goals on becoming a global leader in zero-emissions vehicles (ZEVs); by 2025, 10% of new light-duty vehicles sold in Canada will be zero-emission. By 2030, 30% will be zero-emission, and by 2040, 100% will be zero-emission. To meet these goals, the Government of Canada is offering point-of-sale incentives for customer who buy or lease eligible ZEVs. British Columbia and Quebec are also offering their own rebate programs to incentivize the purchase of ZEVs. To support the wide-spread use of ZEVs, the Government of Canada is also working to deploy a network of vehicle charging stations.

Canada has also put in place greenhouse gas regulations on heavy-duty and light-duty vehicles. The *Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations* (2018) aim to reduce greenhouse gas emissions from heavy-duty vehicles by establishing emission standards and test procedures that are harmonized with federal requirements in the United States. The *Regulations Amending the Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations (2014)* establish progressively more stringent emissions standards, while providing flexibility for compliance in a cost-effective manner. While these regulations target greenhouse gases, rather than black carbon specifically, black carbon reductions are expected to occur as incentives and regulations encourage deployment of cleaner technologies across the transportation sector, thereby displacing diesel-powered engines with greener alternatives.

Best Practices and Lessons Learned

- Distinctive approaches are needed to address emissions from new diesel engines versus legacy engines still in use
- International cooperation is essential to mitigating emissions from shipping in the Arctic

• Effective policy approaches need to recognize the dependence of many Canadian remote communities on diesel as a fuel source, and empower these communities to find solutions that meet their specific needs and circumstances

5.2 Oil and Gas Sources

Oil and gas production, refining and distribution are significant sources of methane emissions, while flaring activities associated with oil and gas production are a significant source of black carbon emissions.

Methane emissions from the oil and gas sector accounted for 42% of Canada's methane emissions in 2017. Emissions from this sector arise from fugitive leaks during the production and transportation of oil and gas product, and from venting and flaring activity at oil and gas production sites. Fugitive leaks made up 18% of Canada's total methane emissions (682 kt) and venting and flaring activity made up 23% of Canada's total emissions (867 kt).



Leakage and venting of methane not only results in emissions, but also represents economic losses for the industry in the form of wasted fuel that could be sold or used to offset on-site energy use. As methane is colorless and odourless, it can be difficult to find leaks along the oil and gas production and distribution chain. However, emerging technologies are offering low-cost ways to detect methane leaks using satellites, airplanes, drones, automobiles mounted with methane sensors, and other monitoring systems. Detecting and repairing leaks, as well as reducing intentional venting and flaring, are some of the lowest-cost, most economical, and most effective ways to reduce methane emissions from the oil and gas sector. Canada is leading the way in addressing these emissions through both technological advancement and regulatory action. In 2016, Canada committed to reduce emissions of methane from the oil and gas sector to 40-45% below 2012 levels by 2025. The governments of British Columba and Alberta have set similar reduction targets to reduce provincial emissions of methane by 25% below 2012 levels by 2025. The Government of Saskatchewan has set a goal of reducing emissions from the upstream oil and gas sector by 4.5 million tonnes of CO₂ equivalent per year by 2025.

For black carbon, flaring activities in the oil and gas sector accounted for 4.3% (1.3 kt) of Canada's emissions in 2017. It is important to note that, while flaring of gas is preferable to venting in terms of reducing methane emissions, increased flaring can lead to increases in black carbon emissions. Therefore, to gain maximum climate and air quality benefits from minimizing methane losses from the oil and gas sector, Canada has committed to zero-routine flaring by

¹³ Reference Figure 2-1 and Figure 3-1 for complete details on black carbon and methane emissions. The graphs shown here are for illustrative purposes.

2030, as outlined in more detail later in this section. Under this commitment, flaring and venting activities are to be avoided wherever safely possible.

New Regulations on Reducing Methane Emissions from the Upstream Oil and Gas Sector

The Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector) (SOR/2018-6) were published by the federal government in 2018, and cover key fugitive and venting emission sources in the upstream oil and gas sector. The regulations came into force on January 1, 2020, and include requirements for: 1) implementing a program to detect and repair leaks of fugitive emissions of natural gas from equipment; 2) measurement of emissions from compressors and corrective action when emissions exceed the applicable limit; and 3) zero venting and conservation of natural gas from wells used for hydraulic fracturing. There are additional requirements, which take effect in 2023, including venting limits and conservation of natural gas requirements from pneumatic devices and general production facilities. The federal regulations were designed in a way to provide industry with flexible options for compliance, and to incentivize innovative solutions and technology development.

Alberta, British Columbia, and Saskatchewan also have provincial measures to control methane emissions. Alberta's oil and gas methane standards are being implemented by the Alberta Energy Regulator. British Columbia's methane emission regulations address the primary sources of methane from the province's upstream oil and gas industry. The B.C. Oil and Gas Commission also recently announced additional regulations for the sector designed to meet or exceed federal and provincial methane reduction targets. The Government of Canada and the British Columbia provincial government have reached an equivalency agreement on methane regulations, which states that provincial law in B.C. is equivalent to the federal regulations regarding methane emissions from the oil and gas sector. Saskatchewan's implementation strategy for achieving emission reductions in the oil and gas sector is outlined in the province's Methane Action Plan. Equivalency agreements are also proposed between the federal government and the provincial governments of Saskatchewan and of Alberta.

Research, Development, and Demonstration

Natural Resources Canada's funding and partnership programs offer funding, grants, and incentives for a variety of projects that innovate in ways that help build a clean economy. There are currently 10 active projects receiving funding for innovative work on detecting, monitoring and mitigating methane emissions from the oil and gas sector.

The <u>Canadian Emission Reduction Innovation Network</u> is a methane-focused initiative launched by Natural Resources Canada and the province of Alberta under the <u>Energy</u> <u>Innovation Program</u>. The network aims to connect facilities and sites across the country to enable coordinated and collaborative research and development. This coordination will enable knowledge and information sharing, as well as provide support for training and development for personnel in the oil and gas sector. The network is expected to reduce compliance costs for industry, accelerate adoption of technologies, and mobilize data sharing across stakeholders.

The **Energy Innovation Program** also funds a variety of other programs that, while not directly focused on methane, are expected to reduce methane emissions indirectly by funding innovations in clean energy technologies. This program supports research, development and demonstration of clean energy technologies, with the aim of helping Canada meet its climate goals.

The **Clean Resource Innovation Network** works to accelerate the development and adoption of innovative solutions to reduce the oil and gas industry's environmental impacts. Budget 2019 announced a \$100M contribution from the federal government to support the network.

ECCC is a leader in global scientific efforts to monitor and assess sources of black carbon and methane from oil and gas production and other sources. This includes studies to reconcile topdown estimates of fugitive methane emissions with real-world observations; work to understand differences between measured and reported methane sources; measuring emissions of black carbon and other pollutants; modelling black carbon emissions at a high level of resolution; and quantifying methane emissions using satellite, aircraft and other methods.

Provinces have been working extensively with the federal government to model emission reductions from regulatory and non-regulatory measures to improve the understanding of methane sources and opportunities to achieve reductions. The **British Columbia Oil and Gas Methane Emissions Research Collaborative (MERC)** is a joint initiative between industry, government, regulators, and non-profits. MERC is advancing research on methane emissions from the oil and gas sector to support efforts to achieve British Columbia's methane emission reduction targets. The <u>Petroleum Technology Alliance Canada</u> (PTAC) is a non-for-profit facilitator that promotes research and technology collaboration in the Canadian oil and gas sector. The **Methane Emissions Reduction Network** within PTAC is a dedicated hub for the sharing of information on all things related to methane reductions in the oil and gas sector.

Outside of governmental actions, Canada is home to many academic institutions and researchers working actively to improve understanding of methane emissions and finding opportunities to achieve reductions.

Flaring in the Oil and Gas Industry

Canada has endorsed the World Bank's "Zero Routine Flaring by 2030" initiative. This initiative aims to minimize routine and non-routine flaring in the oil and gas industry by calling on governments to develop policies and measures that will spur the markets and infrastructure required to utilize gas that would otherwise be vented or flared. Provincial measures in Alberta, British Columbia and Saskatchewan to reduce flaring in the oil and gas industry are helping to achieve this goal.

British Columbia and Alberta have also both recently updated guidelines for venting and flaring following a similar framework for gas operations management, with the ultimate goal of eliminating flaring, incinerating, and venting. The British Columbia Oil and Gas Commission, the

provincial regulatory agency overseeing oil, gas and renewable geothermal operations in British Columbia, released updates to the province's Flaring and Venting Reduction Guideline in May 2018. Also in 2018, the Alberta Energy Regulator amended its Directive 060, which contains provincial requirements for flaring, incinerating and venting in Alberta at all upstream petroleum industry wells and facilities. The amended Directive 060 includes an added requirement to reduce methane emissions.

Best Practices and Lessons Learned

- The oil and gas industry represents some of the best opportunities for low- or zero-net cost methane reduction strategies
- Technology and innovation will play a key role in the implementation of new regulations by offering affordable and accurate measures to detect and repair methane leaks from the oil and gas sector
- Science and monitoring is an important foundation for the development of regulatory and other measures to reduce emissions of black carbon and methane from oil and gas and other sectors.

Innovations in Methane Detection

Methane is an odourless, colourless gas and, as a result, leaks of methane in the oil and gas industry can be difficult to detect, though are often easy to repair. New Canadian regulations requiring the detection and repair of methane leaks from oil and gas production are spurring innovations in methane detection technologies. Research teams across Canada are developing a range of cost-effective technologies that can detect methane leaks at multiple scales, from satellite monitoring to detect large leakages, to field instruments that can detect small leaks on-site. Methane leak detection is not only an opportunity for emission reductions, but also an opportunity for technological advancement and new business ventures. Canadian researchers are working collaboratively with the international science community to identify these opportunities (Ganesan et al., 2019).



5.3 Residential Combustion

Residential combustion refers to the burning of solid fuels, typically firewood or other solid wood products, for the purposes of space and water heating in a residential setting. This emission source is unique in that it is the result of individual household activity, rather than industrial activity.

In Canada, residential combustion in terms of home firewood burning is the second largest source of black carbon, making up 32% (12 kt) of emissions in 2017. Using firewood for primary or secondary heating is



common in homes across many areas of Canada where conventional home-heating fuels, such as natural gas or electricity, are unavailable, expensive, or unreliable, or where wood heat is preferred for cultural or other reasons. Managing emissions from residential wood-burning generally requires a multi-pronged approach: setting regulatory limits on emissions from new wood burning appliances, incentivizing the phase-out of older, higher-emitting appliances, and encouraging the proper use and maintenance of existing stoves to limit their emissions. National programs such as the "Burn It Smart" campaign have been launched in the past, and exploring options for other federal efforts to reduce emissions from wood smoke is an action item suggested in Canada's Strategy on Short-Lived Climate Pollutants.

Provincial Regulations

Five provinces have regulations that address emissions from residential wood-burning appliances: British Columbia, New Brunswick, Newfoundland and Labrador, Nova Scotia, and Quebec. Some municipal or regional jurisdictions have additional regulations to manage the air quality concerns of their region, such as the city of Montreal, Quebec, and the city of Revelstoke, British Columbia. Regulatory approaches vary across provinces and territories; however, most regulations in place refer to Canadian national standards for wood-burning appliances (*CSA B415.1*) and/or U.S. EPA standards (*Standards of Performance for New Residential Wood Heaters*). The majority of appliances available for sale in Canada are manufactured according to U.S. EPA Standards.

Most of the provincial regulations apply only to new stoves, and virtually all modern woodburning appliances available for purchase in Canada meet the CSA or EPA standards (Commission for Environmental Cooperation, 2019). However, wood-burning appliances typically have very long lifetimes, and incentives are often required to encourage homeowners to replace older, high-emitting appliances with cleaner-burning modern units. Change-out programs or rebates have been implemented in many parts of Canada, including British

¹⁴ Reference Figure 2-1 for complete details on black carbon emissions. The graph shown here is for illustrative purposes.

Columbia, Ontario, New Brunswick, Newfoundland and Labrador, Prince Edward Island, Nova Scotia, Yukon, and the Northwest Territories.

Best Practices and Lessons Learned

- Certification of new appliances helps ensure that the marketplace only offers the cleanest-burning devices
- Incentives to switch-out old wood-burning appliances with new cleaner-burning ones, helps ensure that old appliances are not returned to use elsewhere

5.4 Solid Waste (Landfills)

Landfilling of solid waste is a common practice in Canada. Municipal solid waste landfills accounted for 13% (668 kt) of Canada's total methane emissions in 2017. Organic waste, such as food, yard waste, and paper, slowly decomposes when disposed in a typical Canadian landfill. This slow decomposition of waste in landfills generates methane gas over the course of multiple decades. Actions to reduce methane emissions from solid waste can be described in three main categories: (1) capture landfill gas currently being emitted; (2) avoid future emissions by diverting organic waste from landfills; and (3) reduce the amount of waste generated, thus avoiding emissions across the production, transport, and disposal chain.



In Canada, the collection, processing, and disposal of waste is managed at the municipal, regional, and provincial levels. Federal action in these areas includes reporting on statistics and trends; creating tools, reports, and recommendations for best practices; and developing programs that offer financial or other supports to improve waste management practices.

Landfill Gas Collection

There are more than 3000 active and closed solid waste landfills across Canada. The 280 largest landfills, each with more than 100 kilotonnes of disposed waste in place, account for an estimated 60% of methane emissions from landfills. Landfill gas capture is regulated in some Canadian provinces. Ontario, British Columbia, and Quebec require landfill gas capture from landfills that exceed waste disposal or methane generation thresholds. Other provinces do not have regulatory requirements to capture landfill gas, however, most large and medium-sized landfills capture some amount of landfill gas. Over 100 Canadian landfills have landfill gas collection systems.

¹⁵ Reference Figure 3-1 for complete details on methane emissions. The graph shown here is for illustrative purposes.

Captured landfill gas is generally either flared or used to generate electricity and/or heat. Recent technological advancements are also allowing the processing of landfill gas into renewable natural gas, which can be fed into natural gas pipelines, or the upgrading of landfill gas into transportation fuel. Flaring of landfill gas occurs when power generation equipment is not available on-site, when equipment is off-line for maintenance purposes, or when the installation of infrastructure to utilize captured methane is not cost-effective. Many large landfill facilities across Canada generate heat or power from landfill gas, either for use on-site, or to be fed into local power utility networks. Electricity generated from landfill gas is considered renewable energy. As carbon pricing regulations and the Clean Fuel Standard come into force, there is expected to be an increase in demand for "biogas" produced from landfills, and increased revenue potential in the form of offset credits for certain landfills that install landfill gas capture systems.

While landfill gas capture can be economical in the long-term, the up-front costs of installing a system or expanding a current system can be prohibitive. Responding to this challenge, several landfill gas capture projects have successfully received funding through Canada's Low Carbon Economy Fund.

Diverting Organics from Landfills

Policies and regulations that mandate or encourage the diversion of organic waste from landfills are in place or are being developed in British Columbia, Alberta, Manitoba, Ontario, Quebec, Nova Scotia and Prince Edward Island. Many municipal and regional governments also have organic diversion strategies that are tailored to their local circumstances.

Reducing Food Waste

In 2015, Canada committed to the United Nation's 2030 Agenda for Sustainable Development, which includes Sustainable Development Goal 12.3 to "halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chain, including post-harvest losses" by 2030.

In 2019, Environment and Climate Change Canada released the "<u>Taking Stock: Reducing</u> <u>Food Loss and Waste in Canada</u>" report. This report summarizes the current state of knowledge and practices in Canada regarding food loss and waste. The causes of food waste at each step in the production cycle are identified, and key actions are identified where improvement could be made. This report will help guide ongoing actions to reduce food waste across Canada.

Best Practices for Northern and Remote Communities

In March 2017, Environment and Climate Change Canada released the <u>Solid Waste</u> <u>Management for Northern and Remote Communities – Planning and Technical</u> <u>Document</u>. This document was the result of a collaborative effort between the Government of Canada and territorial governments to provide guidance on the planning, design, operation and closure of municipal waste management facilities in northern and remote regions of Canada. The recommendations outlined in the report were made in context of the unique circumstances and challenges that northern and remote communities face in managing their waste. Landfilling is not always possible in the North, and so alternative disposal methods, including incineration, are common.

Best Practices and Lessons Learned

- Waste collection, disposal and management practices vary across Canada. Coordination of resources and information sharing across multiple levels of government is important to address regional issues related to waste diversion.
- The waste sector represents an opportunity to invest in infrastructure that can help achieve near-immediate emissions reductions, such as landfill gas capture equipment, and organic waste diversion resources and facilities.

Low Carbon Economy Fund

Canada's Low Carbon Economy Fund (LCEF) was designed to provide funding to projects that can demonstrate reductions in greenhouse gas emissions and generate clean growth. The LCEF has found success with waste-related projects, demonstrating that there are many opportunities to reduce emissions from the waste sector with supportive funding. The following projects will contribute directly to the reduction of methane emissions from Canada's waste sector.



Brady Road Landfill is Manitoba's second largest point-source emitter of greenhouse gases. LCEF Funds will improve gas collection efficiency at the landfill from 48% to 75%.



The Centre de Traitement de la Biomasse de la Montérégie Inc. was awarded funding to install equipment to transform organic waste into renewable energy and biofertilizer.



Funds from the LCEF will be matched by the government of British Columbia to expand organic waste infrastructure, such as composting facilities, and anaerobic digesters, to increase the rate of waste diversion from landfills.

5.5 Agriculture and Animal

Husbandry

In Canada, enteric fermentation, the digestive process of ruminant livestock animals, accounts for 26% of Canada's methane emissions. Open burning as an agricultural process was also identified by the Expert Group as a major source of black carbon, however, open burning is not a common agricultural activity in Canada, and is not considered a major Canadian source of emissions.





The Agricultural Greenhouse Gases Program (AGGP) is a \$27 million five-year program (2016-2021) that supports research and development of technologies, practices and processes that can be adopted by farmers to mitigate greenhouse gas emissions, including methane. The AGGP focuses on four priority areas – livestock systems, cropping systems, agricultural water use efficiency, and agroforestry. Accepted projects receive up to \$2 million in support. Among the approved projects in the AGGP are projects developing strategies for reducing greenhouse gas emissions from Canadian cattle farms, including using biochar as a possible diet additive to reduce emissions from beef cattle. Projects under the AGGP are expected to result in enhanced understanding and expanded used of agricultural technologies and best management practices by Canadian farmers.

Food Policy for Canada

Agriculture and Agri-Food Canada released <u>A Food Policy for Canada: Everyone at the</u> <u>Table</u> in 2019. The purpose of this policy is to build a more sustainable food system while supporting growth for farmers, producers, and food businesses in Canada. There are six priority outcomes for the strategy. One is sustainable food practices through the use of practices along the food value chain that reduce environmental impact and that improve the climate resilience of the Canadian food system. Specific targets will be developed under this strategy that will align with the United Nations Sustainable Development Goals regarding Zero Hunger (SDG 2), Good Health and Well-Being (SDG 3), Responsible Production and Consumption (SDG 12), and Climate Action (SDG 13).

¹⁶ Reference Figure 3-1 for complete details on methane emissions. The graph shown here is for illustrative purposes.

Best Practices and Lessons Learned

• Support research and development to develop improved agricultural practices that reduce greenhouse gas emissions, including methane

5.6 Wildfires

Wildfires are increasing globally in intensity and frequency as a result of complex interactions between climate change and some land management practices. Wildfires release large amounts of black carbon, and those emissions often travel to Arctic areas, where they can cause further warming and melting. For this reason, the Arctic Council's Expert Group on Black Carbon and Methane added management of wildfires as an area for recommended action to reduce black carbon emissions.

Emissions from wildfires are not included in Canada's official black carbon inventory, which focuses on emissions from anthropogenic sources. However, Environment and Climate Change Canada estimates emissions from wildfires for air quality purposes using the <u>FireWork</u> forecast system. This system was created to provide near-immediate data on PM_{2.5} emissions resulting from biomass-burning events, in order to forecast pollutant concentrations as part of Canada's Air Quality Health Index program. FireWork, along with other air pollutant modelling systems, feeds into the Air Quality Health Index program to inform Canadians about current air quality conditions.

The FireWork system runs twice daily, and estimates emissions using near-real-time "hotspot" detection data from satellites, along with estimated fuel consumption data from Natural Resources Canada's Canadian Wild Fire Information System. As wildfire smoke can be transported thousands of kilometers downwind, one of the most valuable functions of the FireWork system is the production of wildfire smoke forecast maps, which predict how smoke from wildfires is expected to move across North America over the next 48 hours.

Figure 5-2 shows annual estimated black carbon emissions from the FireWork system, compared to total anthropogenic emissions from Canada's Black Carbon Inventory for the years 2016 and 2017. Caution should be taken in comparing emission estimates from these two different sources. Nonetheless, this comparison does highlight the magnitude of black carbon emissions from wildfires in Canada. Exposure to wildfire smoke, including the black carbon component of that smoke, can lead to a wide range of health problems, ranging from asthma to heart failure to lung conditions (Cascio, 2018). Furthermore, powerful plumes formed by wildfire events can inject emissions high into the atmosphere, where they can be transported long distances by strong winds. For example, black carbon deposits on the Greenland ice sheet in 2014 were linked to emissions from Canadian wildfires during the 2013 fire season (Thomas et al., 2017).





Wildfires are highly variable from year to year, and can be difficult to predict. Therefore, emissions resulting from wildfire events are also variable. The two years shown in Figure 5-2 represent relatively low years of fire activity in terms of total area burned and number of fires. (Natural Resources Canada, n.d.).

In the Arctic context, wildfire events are also strongly seasonal. Black carbon from wildfires is a dominant source of Arctic black carbon emissions during the summer months, while anthropogenic sources of black carbon dominate in the late winter/early spring (Winiger et al.,

¹⁷ Anthropogenic emissions are the total emission estimates reported in Canada's Black Carbon Inventory

2019). In the summer, black carbon suspended in the atmosphere tends to be removed more quickly through natural processes than in the winter, where slow removal processes lead to Arctic haze (Shen, Ming, Horowitz, Ramaswamy, & Lin, 2017). Ice and snow are most vulnerable to the darkening effects of black carbon in the late winter and early spring, when anthropogenic sources are dominant. Therefore, despite the larger magnitude of wildfire emissions, which occur in the summer and early autumn, anthropogenic emissions can have a disproportionately greater impact on Arctic ecosystems and air quality in the spring and winter.

Wildfire Management

Provincial and territorial agencies have the responsibility for wildland fire management in most of Canada's forests. Federal government agencies are responsible for wildfire management in national parks, military bases and on other federal lands. However, collaboration between all agencies is an essential part of information-sharing, resource coordination, research, and wildfire risk management and response activities.

The Canadian Forest Service, part of Natural Resources Canada, works closely with provinces and territories on forest management. The Canadian Forest Service produces a range of tools for forest managers for assessing fire danger, predicting fires and responding as necessary. The **Canadian Wildland Fire Information System** creates maps on fire weather, fire behaviour and fire hotspots on a daily basis during Canada's forest fire season (May – September). These maps are critical in assessing fire danger across Canada, tracking fire behaviour over time, and predicting when and where new fire activity could occur. The **Canadian Forest Fire Danger Rating System** (CFFDRS) is another important tool produced by the Canadian Forest Service. The CFFDRS is a national system for rating the risk of forest fires in Canada that uses information about weather, topography, fuels, and risks of ignition to produce indicators of fire risk to guide fire management activities.

In 2016, the Canadian Council of Forest Ministers, a cooperative group composed of fourteen federal, provincial and territorial ministers, produced the <u>Canadian Wildland Fire Strategy</u> which built on the initial strategy produced in 2005. The updated Strategy provides a 10-year update on progress of the 2005 Strategy, and outlines required next steps. This document summarizes the current state of wildfire management in Canada and progress made towards the goals of the Strategy, and outlines next steps required to continue to meet the challenges of wildfire management across the country.

The <u>Canadian Interagency Forest Fire Centre</u> (CIFFC) is a not-for-profit corporation owned and operated by federal, provincial and territorial wildfire management agencies. CIFFC coordinates resource sharing, mutual aid, and information sharing across regions and agencies. On the international stage, CIFFC works closely with the Government of Canada to coordinate Canadian response to international requests for assistance.

Best Practice and Lessons Learned

• Forest management strategies should recognize the important ecological role that fire plays in forest ecosystems and develop management strategies accordingly

- Information sharing is key to ensuring that regional agencies have the information required to plan response strategies for the highest risk areas
- Cooperation and open communication between all levels of government is essential to rapid response and mobilization of resources in response to wildfire events.

6. International Engagement

Canada is actively engaged in international efforts to address black carbon and methane. Engaging internationally, and building partnerships to reduce short-lived climate pollutants on a global scale, are key elements of Canada's SLCP Strategy published in 2017. This is done through a number of international fora as outlined below.

Arctic Council

The Arctic Council is the leading intergovernmental forum promoting cooperation, coordination and interaction among Arctic States. Canada was the first chair of the Arctic Council from 1996-1998, and chaired again from 2013-2015.

The Arctic Council was one of the first international fora to recognize the importance of taking action on short-lived climate pollutants, including black carbon and methane. A number of groups under the Arctic Council are working to monitor and reduce these emissions, including: (1) the Expert Group on Black Carbon and Methane; (2) the Arctic Monitoring and Assessment Program (AMAP); and (3) the Arctic Contaminants Action Program (ACAP). Canada is active in each of these groups.

United Nations Economic Commission for Europe

The 1979 Convention on Long-range Transboundary Air Pollution, of the United Nations Economic Commission for Europe is the only legally binding international instrument aimed at addressing air pollution. Canada has been a Party to the Convention since 1981. The Convention includes eight protocols. With the addition of fine particulate matter (PM_{2.5}) to the 1999 Gothenburg Protocol, it became the first international treaty to include a focus on SLCPs, by asking Parties when meeting their PM_{2.5} commitments, to prioritize sources of particulate matter which are also significant sources of black carbon. Canada ratified the Gothenburg Protocol in 2017.

Global Methane Initiative

The Global Methane Initiative (GMI) is a voluntary, multilateral partnership that aims to reduce methane emissions and advance the recovery and use of methane as a fuel source. The GMI includes 45 partner countries, and over 1300 network members from the private sector, research community, development banks and other governmental and non-governmental organizations. The GMI focuses on three major sources of methane globally – oil and gas, biogas (including landfills, wastewater, and agriculture) and coal mining. Canada has co-chaired

the GMI Steering Committee since 2016, and also co-chairs the GMI sub-committees for oil & gas and biogas.

In April 2018, Canada hosted the 2018 Global Methane Forum in Toronto, which was organized by the GMI in partnership with the Climate and Clean Air Coalition. The Forum brought together government, industry, non-profit sector and academic representatives from more than 50 countries to discuss and advance methane mitigation, science and technology innovation.

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. The CCAC is committed to improving air quality and protecting the climate through actions to reduce short-lived climate pollutants, including black carbon and methane. Canada was a founding partner of the CCAC and served as co-chair of the CCAC Working Group from 2016-2018. Canada has also been a top donor to the Coalition's Trust Fund, which primarily supports the implementation of activities to reduce emissions of short-lived climate pollutants in developing countries. The CCAC works to reduce SLCPs through initiatives that target specific sectors, such as waste, brick manufacturing, household energy, oil and gas, efficient cooling and agriculture, as well as cross-cutting initiatives in finance, health, and support for national policy and action planning.

Commission for Environmental Cooperation

The Commission for Environmental Cooperation (CEC) was established in 1994 by Canada, Mexico and the United States to support cooperation under the North American Agreement on Environmental Cooperation. The CEC focuses on environmental issues of continental scope, including emissions of short-lived climate pollutants. Since 2012, the biennial work plans have included projects to improve black carbon inventories from small-scale biomass operation, reduce pollution from marine transport, and prevent and reduce food loss and waste.

International Maritime Organization

The International Maritime Organization (IMO) is the United Nations agency responsible for setting global standard applicable to international shipping. Canada is providing expert technical support, policy advice, and emissions testing expertise relating to air pollutant and greenhouse gas emissions from ships, as the IMO is taking actions to reduce the impacts of black carbon emissions from international shipping on the Arctic environment.

International Civil Aviation Organization

The International Civil Aviation Organization (ICAO) is the United Nations agency responsible for the safe and cooperative development of international civil aviation. As with the IMO, Canada provides expert technical support and policy advice to ICAO, including addressing black carbon emissions from global aviation activity.

North American Climate, Clean Energy, and Environment Partnership

In 2016, Canada, Mexico, and the United States jointly announced the North American Climate, Energy, and Environment Partnership at the North American Leader Summit. This announcement was accompanied with specific commitments to reduce emissions of short-lived climate pollutants. Through this Partnership, Mexico joined Canada and the U.S. in committing to reduce methane emissions from the oil and gas sector to 40-45% by 2025.

North American Climate Leaders' Dialogue

In 2017, Canada, Mexico, and the U.S. Climate Alliance (a bipartisan coalition of 25 U.S. Governors committed to climate action), agreed to strengthen climate initiatives through the North American Climate Leadership Dialogue. The Dialogue acknowledges the importance of addressing short-lived climate pollutants to help achieve climate and air quality goals.

7. Conclusion

Canada is committed to reducing emissions of black carbon and methane, and working collaboratively under the Arctic Council and other international fora to reduce emissions on a global scale.

Addressing black carbon and methane will help mitigate climate change, while also improving air quality and supporting national and global clean economic growth.

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Annex 1: Linkage to Recommendations Made by the Expert Group on Black Carbon and Methane

This section summarizes Canadian policies on actions to reduce or mitigate emissions of black carbon or methane. It includes the newly announced or implemented policies discussed in Section 5 of this report, as well as existing programs or regulations. Where appropriate, provincial regulations are described, as they have the regulatory lead for certain sectors.

| Recommendations | Canadian Actions |
|---|--|
| 1a: Reduce emissions from new diesel vehicles and engines by adopting and implementing world- class particulate matter exhaust emission standard and ensuring wide-spread availability of ultra-low sulphur fuels | Off-road Compression-Ignition (Mobile and Stationary) and Large Spark-Ignition Engine Emission Regulations Clean Fuel Standard Sulphur in Diesel Fuel Regulations |
| 1b: Reduce emissions from legacy diesel vehicles and engines by adopting targeted policies and programs | Mandatory emission testing in some provinces for heavy-duty diesel vehicles |
| 1c: Reduce black carbon by stimulating the shift to alternative vehicles and modes of transportation, and through efficiency measures | The i-ZEV rebate program for purchase or lease of a zero-emission vehicle Tax write-offs offered to businesses for the purchase of zero-emission vehicles |
| 1d: Develop, as appropriate, and report on measures and best practices to reduce particulate matter and black carbon emissions from shipping | Collaborative work through the International Maritime Organization to reduce emissions of particulate matter including black carbon from shipping |
| 1e: Reduce emissions from stationary diesel engines by adopting targeted policies and programs, including shift to new technologies and improved efficiency | Clean Energy for Rural and Remote Communities Program Indigenous Off-Diesel Initiative Challenge Northern Responsible Energy Approach for Community Heat and Electricity Program |

Mobile and Stationary Diesel-Powered Sources

Oil and Gas

| Recommendations | Canadian Actions |
|---|---|
| 2a: Adopt and implement oil and gas methane emissions reduction strategies | Federal Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector) (SOR/2018-6) British Colombia's regulation Drilling and Production Regulation under the Oil and Gas Activities Act (<i>B.C.</i> <i>Reg 282/2010</i>) Saskatchewan's Methane Action Plan Alberta's Directives 060 and 017 |
| 2b: Encourage the adoption of best practices in reducing routine flaring and improving gas capture | British Columbia Oil and Gas Commission Flaring and Venting Reduction Guideline (2018) Alberta Energy Regulator Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting Directive S-10: Saskatchewan Upstream Petroleum Industry Associated Gas Conservation Newfoundland and Labrador Regulation 120/09: Offshore Petroleum Drilling and Production Regulations |
| 2c: Urge firms to engage in international and domestic voluntary methane and black carbon reduction activities, including the implementation of methane management strategies | Canada is currently co-chair of the Global Methane Initiative, as well as co-chair of the Oil and Gas Subcommittee under the Global Methane Initiative. |
| 2d: Promote targeted and cost-effective measures at large methane emissions sources, where relevant | Developing a national Clean Fuel Standard. Alberta's Energy Innovation Program British Columbia's Clean Growth Infrastructure Royalty Program Alberta's Methane Emissions Reduction program |

Residential Combustion

| Recommendations | Canadian Actions |
|---|--|
| 3a: Reduce emissions from new solid fuel combustion appliances by accelerating deployment of cleaner and more efficient heating sources and by promoting proper operation and maintenance of appliances, including | Provincial/Municipal Regulations Canadian Council of Ministers of the Environment Code of Practice for Residential Wood Burning Canadian Council of Ministers of the Environment Guidance Manual on Regulating Air Emissions from Small Solid Biomass Combustors |
| storage and treatment of fuels | |
| 3b: Reduce emissions from legacy solid | Ottawa Wood Burning Change-out Program |
| fuel combustion appliances by | Ontario Home Energy Conservation Incentive |
| accelerating replacement with cleaner | Program |
| and more efficient new heating sources | New Brunswick Wood Stove Change-out Program |
| and promoting proper operation and | Yukon Heating Systems Rebate Program |

| maintenance of appliance, including storage and treatment of fuels | - | British Columbia Provincial Wood Stove Exchange Program Quebec Changez d'Air program |
|---|---|--|
| 3c: Reduce emissions by promoting enhanced energy efficiency in residential dwelling, reducing the need to heating, especially in building heated with oil or solid fuels | - | Burn it Smart regional campaigns |

Solid Waste

| Recommendations | Canadian Actions |
|---|---|
| 4a: Avoid methane emissions by preventing food waste and the landfilling of organic waste. Improve resource efficiencies as appropriate for Arctic conditions, including new ways of reusing organic material based on more efficient sorting of waste, composting and biogas production | Food Policy for Canada Reducing Food Loss and Waste in Canada Workshop (June 2019) Love Food, Hate Waste Canada Municipal landfills bans and provincial diversion objectives in British Columbia Mandatory organics diversion programs in Alberta and Prince Edward Island. Provincial diversion goal in Manitoba Proposed landfill ban in Ontario, Quebec, and Nova Scotia |
| 4b: Adopt regulations or incentives for landfill gas capture and control | Ontario requirements for landfill gas collection and flaring (<i>O. Reg</i> 232/98 and <i>Reg</i> 347) British Columbia Landfill Gas Management Regulation Quebec Regulations respecting the landfilling and incineration of residual materials Alberta Carbon Competitiveness Incentive Regulation (does not directly target landfills, but includes landfill that emit over 1000 kt CO2e annually) |
| 4c: Promote best practices for waste management in northern and remote communities | Solid Waste Management for Northern and Remote Communities: Planning and Technical Guidance Document (Environment and Climate Change Canada, 2017) |

Agriculture and Animal Husbandry

| Recommendations | Canadian Actions |
|--|--|
| 5a: Promote food consumption patterns | Canada is developing a national food strategy. |
| that utilize Arctic food chains | Supporting food security in Northern and Indigenous |
| sustainably and efficiently, support the | communities is one of four key areas identified as |
| preservation of carbon sinks, and | priorities in developing this Strategy. |

| minimize life-cycle emissions of | |
|--|---|
| methane | |
| 5b: Promote work on possibilities to reduce emissions of enteric methane under Arctic conditions, in co-operation with relevant organizations | - Agricultural Greenhouse Gases Program |
| 5c: Develop agricultural policies and practices to reduce open burning of agricultural waste. Encourage studies and piloting of innovative solutions that reduce the need for open burning | Canadian Council of Ministers of the Environment Guidance Document for Canadian Jurisdictions on Open-Air Burning |

Management of Wildfires

| Recommendations | Canadian Actions |
|--|--|
| 6a: Build and maintain international mutual aid and resource exchange arrangements amongst Arctic nations that have specialized experience in wildfire management, suppression, and monitoring | - Canadian Interagency Forest Fire Centre |
| 6b: Develop region-specific public education campaigns on wildfire prevention and safety | - FireSmart campaigns |
| 6c: Develop and implement regionally appropriate forest management practices that reduce the risk of severe wildfires | Canadian Wildland Fire Strategy Ecosystem-based Management Emulating Natural Disturbances (EMEND) project. |
| 6d: Use the best available science to develop prediction models that can be used to examine fire risks at daily to decadal scales, to support drafting of prevention and emergency response plans | Canadian Wildland Fire Information System Canadian Forest Fire Danger Rating System Canadian Fire Effects Model FireWork air quality forecast system Smoke dispersion modelling WildFireSat (under development) |