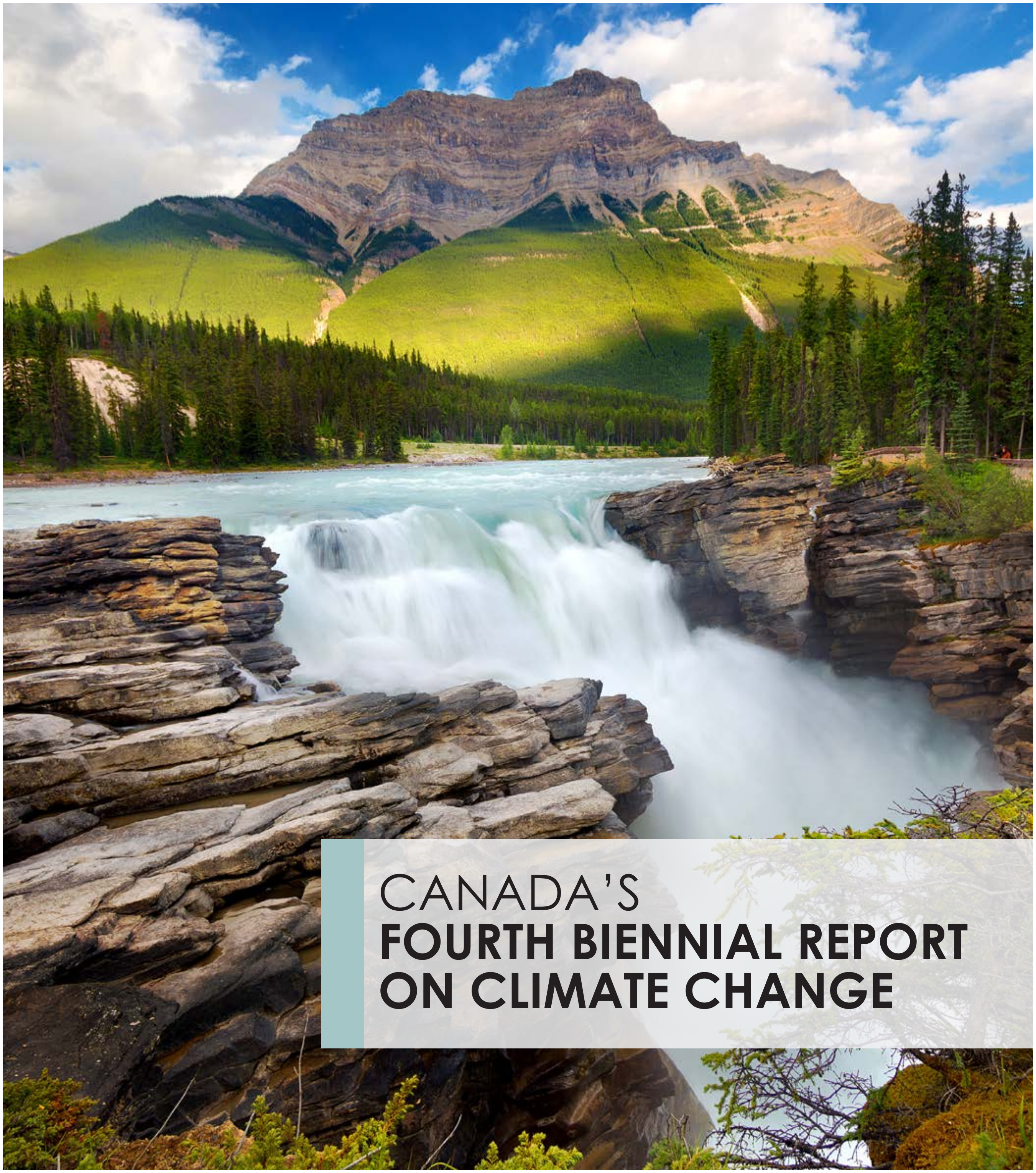
Government of Canada Gouvernement du Canada

Canada



CANADA'S FOURTH BIENNIAL REPORT ON CLIMATE CHANGE

Canada's 4th Biennial Report to the United Nations Framework Convention on Climate Change (UNFCCC)

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MINISTER'S MESSAGE

As Minister of Environment and Climate Change, I am pleased to submit Canada's *Fourth Biennial Report* to the United Nations Framework Convention on Climate Change.

Our children and grandchildren will judge this generation by its action – or inaction – on the defining challenge of our time: climate change. From forest fires and floods, to ocean pollution and coastal erosion, Canadians are living the impact of climate change every day.

Since the adoption of Canada's national climate plan – the Pan-Canadian Framework on Clean Growth and Climate Change – in 2016, the calls for urgent climate action have continued to grow. Our country's science-based report, *Canada's Changing Climate* published in April 2019, indicates that warming in Canada is occurring at twice the global average speed. Canada's north is actually warming at three times that rate.

The scientific community, civil society, youth representatives, Indigenous peoples, industry and others continue to stress the urgency of climate change. This is why Canada is working to develop policies according to what is needed to avoid the worst impacts.

Federal, provincial, and territorial actions taken in the last few years have slowed emissions growth, and we are now projecting a significant decline for the first time in Canada's history. While it is still feasible to avoid a 1.5°C rise in temperature, changes including how we produce and transport goods, and how we generate and use energy- will be needed. We recognize the challenges in addressing climate change and the urgent need for action at all levels. At the same time, we recognize that there is now an opportunity to stimulate innovation and take a leadership position in the low-carbon economy.

We know we need to do more. That is why the federal government has committed to exceeding current 2030 targets and developing a plan to achieve net-zero emissions by 2050. Canada will continue to take concrete action to protect the environment, and will do so in a way that grows the economy and makes life more affordable. We will make significant investments in public transit; use nature-based solutions, including planting two billion new trees, to clean the air and make our communities greener; and, we will work to advance legislation to support the future and livelihood of workers and their communities in the transition to a low-carbon global economy.

The Government will also act to preserve Canada's natural legacy, protecting 25% of Canada's land and 25% of Canada's oceans by 2025, and will continue efforts to reduce plastic pollution.

I look forward to continue working with my domestic and international colleagues to make this future a reality.

Sincerely,
Jonathan Wilkinson
Minister of Environment and Climate Change

1.0 INTRODUCTION

Canada is pleased to present its Fourth Biennial Report to the United Nations Framework Convention on Climate Change (UNFCCC).

Since Canada's last National Communication and Biennial Report[1], Canada has continued to implement its national climate change plan, the Pan-Canadian Framework on Clean Growth and Climate Change (the Pan-Canadian Framework), and work towards reducing greenhouse gas (GHG) emissions across the economy. Canada welcomes this opportunity to highlight its international emission reduction targets, as well as ongoing mitigation efforts, emissions trends and projections, and international climate finance contributions.

The Pan-Canadian Framework was adopted on December 9, 2016 as Canada's plan to take ambitious action to fight climate change, build resilience to a changing climate, and drive clean economic growth. It is the first climate change plan in Canada's history to include joint and individual commitments by federal, provincial and territorial levels of government, and to have been developed with input from Indigenous Peoples, businesses, non-governmental organizations, and Canadians from across the country. The Pan-Canadian Framework is built on four pillars: pricing carbon pollution, complementary actions to reduce emissions across the economy, adaptation and climate resilience, and clean technology, innovation, and jobs. It includes more than fifty concrete actions that cover all sectors of the Canadian economy, and puts Canada on a path towards meeting our Paris Agreement GHG emissions reduction target of 30% below 2005 levels by 2030.

Canada's most recent GHG emissions projections estimate that Canada's GHG emissions in 2030 will be 227 million tonnes lower than projected prior to the Pan-Canadian Framework or 19% below 2005 levels. This improvement, equivalent to approximately a third of Canada's emissions in 2005, is widespread across all economic sectors, reflecting the breadth and the depth of the Pan-Canadian Framework.

Building on the success of the Pan-Canadian Framework, Canada's federal government announced in December of 2019 that it will set a target to achieve net-zero emissions by 2050. This will include setting legally-binding, five-year emissions-reduction milestones based on advice of experts and consultations with Canadians. This ambitious goal will be supported by a continued commitment to ensuring a price on carbon pollution is in place everywhere in Canada, as well as prioritization of measures including green buildings and communities,

1 Canada's Seventh National Communication and Third Biennial report, December 2017

support for zero-emission vehicles, clean electricity, clean technology, and nature-based climate solutions. This includes a specific commitment to planting 2 billion trees in the coming years. Canada is determined to meet and exceed its Paris Agreement target.

Since Canada's climate plan was adopted, the Government of Canada has continued to provide national leadership and to partner with provincial and territorial governments, and to work with municipal governments, as well as Indigenous Peoples, businesses, civil society, and Canadians to address climate change both domestically and internationally to make the transition towards a clean economy.

This report provides an update of key actions that Canada has taken to drive down GHGs and achieve its 2020 and 2030 mitigation targets since Canada's last National Communication and Biennial Report, published at the end of 2017.

For example, Canada now has a price on carbon pollution across the country. In 2018, the *Greenhouse Gas Pollution Pricing Act* was passed. Carbon pollution pricing systems are now in place in all provinces and territories across Canada (either provincial/territorial systems or the federal system).

In addition, federal, provincial, and territorial governments continued to make progress on implementing a host of complementary actions to reduce GHG emissions. This includes significant developments in the electricity sector, with new federal regulations to phase-out coal-fired electricity by 2030. These regulations will not only lower GHG emissions, but will also contribute to improved health outcomes for Canadians and ecosystems through improved air quality. In the industrial sector, regulations to phase down the consumption of hydrofluorocarbons (HFCs) entered into force. These regulations aim to reduce the supply of HFCs that enter Canada and the demand for HFCs in manufactured products, thereby averting future HFC releases to the environment.

Governments also made significant investments to increase renewable energy capacity; expand green, resilient infrastructure; support zero or low-emitting transportation; and harness mitigation opportunities within the agriculture, forestry, and waste sectors. For example, federal, and some provincial, governments pursued measures to increase the number of zero-emission vehicles on the road, including expanding charging infrastructure and introducing purchase incentives. Additionally, with a view to identifying further mitigation opportunities in the building and transportation sectors, the federal government struck the Advisory Council on Climate Action, which published its final report in May 2019. Also in 2019, the Task Force on Just Transition for Canadian Coal Power Workers and Communities provided recommendations to support the transition of coal workers and communities affected by the move from coal-fired to cleaner electricity.

Work has also been advanced to reduce emissions in the oil and gas sector, Canada's largest source of emissions. New federal regulations to reduce methane emissions will enter into force on January 1, 2020. A number of provinces have also been working to reduce emissions from this sector though new technologies and standards.

At the same time, investments continued to support the development of clean technology, which will complement and help achieve the reductions targeted by various mitigation measures in addition to bringing Canadian technologies to expanding global markets and equipping Canada's workforce with the knowledge and skills to succeed.

In 2015, in support of the Paris Agreement, Canada pledged $2.65 billion over five years in climate finance to pursue ambitious action on climate change in developing countries. Canada is delivering on its commitment by implementing concrete initiatives through various multilateral and bilateral partners. Through its climate finance, Canada also helps to empower women and girls through climate action and mobilizes private-sector capital to address climate change.

2.0 CANADA'S GREENHOUSE GAS EMISSIONS AND TRENDS

Canada's National Greenhouse Gas Inventory is prepared and submitted to the UNFCCC by April 15 of each year, in accordance with the revised Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories (UNFCCC Reporting Guidelines), adopted through Decision 24/CP.19 in 2013. The annual inventory submission consists of the National Inventory Report and the Common Reporting Format tables.

The GHG inventory includes emissions of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3) in the following five sectors: Energy; Industrial Processes and Product Use (IPPU); Agriculture; Waste; and Land Use, Land-Use Change and Forestry (LULUCF). The GHG emission and removal estimates contained in Canada's GHG inventory are developed using methodologies consistent with the Intergovernmental Panel on Climate Change's (IPCC) 2006 Guidelines for the preparation of National GHG Inventories. In line with the principle of continuous improvement, the underlying data and methodologies for estimating emissions are revised over time; hence, total emissions in all years are subject to change as both data and methods are improved.

Over the 2005-2017 period, total emissions decreased by 15 Mt or 2% (Figure 2.1). The Energy Sector dominated this trend, with emission decreases of 15 Mt (4%) in Stationary Combustion Sources and 5 Mt (9%) in Fugitive Sources. Over the same period, emissions also decreased by 1.8 Mt (3%) in the IPPU Sector and 1.4 Mt (7%) in the Waste Sector. However, emissions from Transport increased by 9.0 Mt (5%) partially offsetting the decreases from the other sectors.

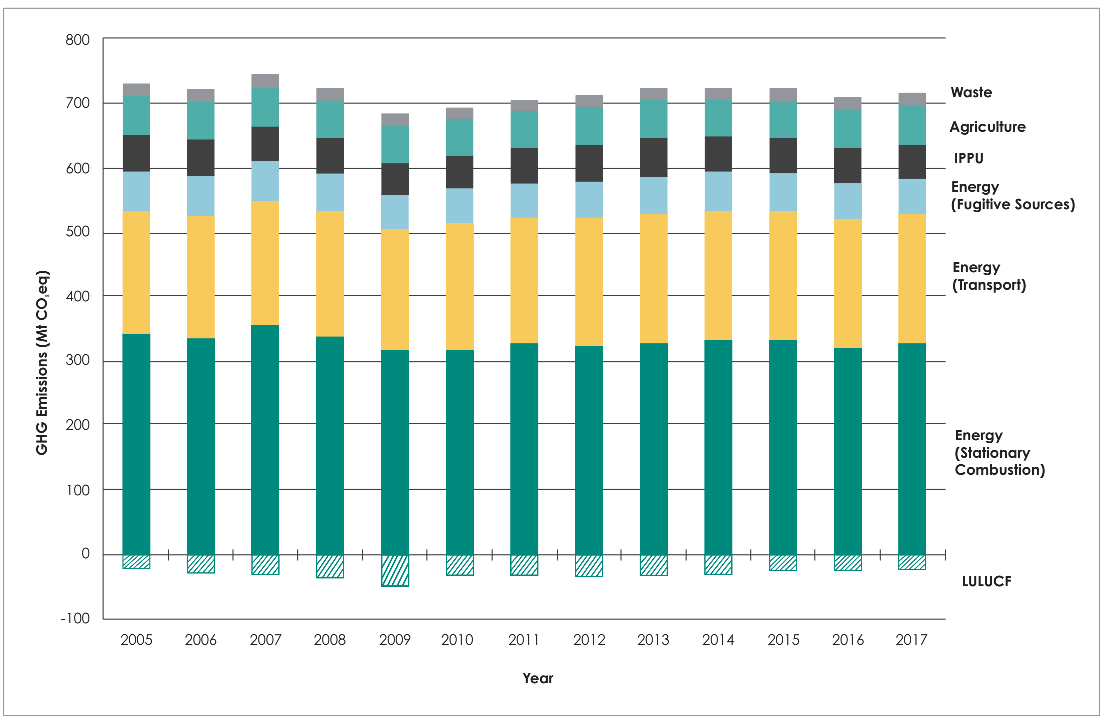


Figure 2.1: Trends in Canadian GHG Emissions by IPCC Sector (2005–2017)
Source: National Inventory Report 1990-2017 – Greenhouse Gas Sources and Sinks in Canada

2.1 Canadian Economic Sectors

For the purposes of analyzing economic trends and policies, it is useful to allocate emissions to the economic sector from which the emissions originate. In general, a comprehensive emission profile for a specific economic sector is developed by reallocating the relevant proportion of emissions from various IPCC subcategories. This reallocation simply recategorizes emissions under different headings and does not change the overall magnitude of Canadian emissions estimates. In addition, Canadian economic sectors presented in Canada's GHG Inventory are used to project Canada's future GHG estimates.

GHG emissions trends in Canada's economic sectors from 2005 to 2017 are consistent with those described for IPCC sectors, with the Oil and Gas and Transportation economic sectors showing emission increases of 37 Mt (23%) and 12 Mt (7%) respectively since 2005 (Figure 2.2). These increases have been more than offset by emission decreases in Electricity (45 Mt or 38%), Heavy Industry (14 Mt or 16%) and Waste & Others (4 Mt or 9%).

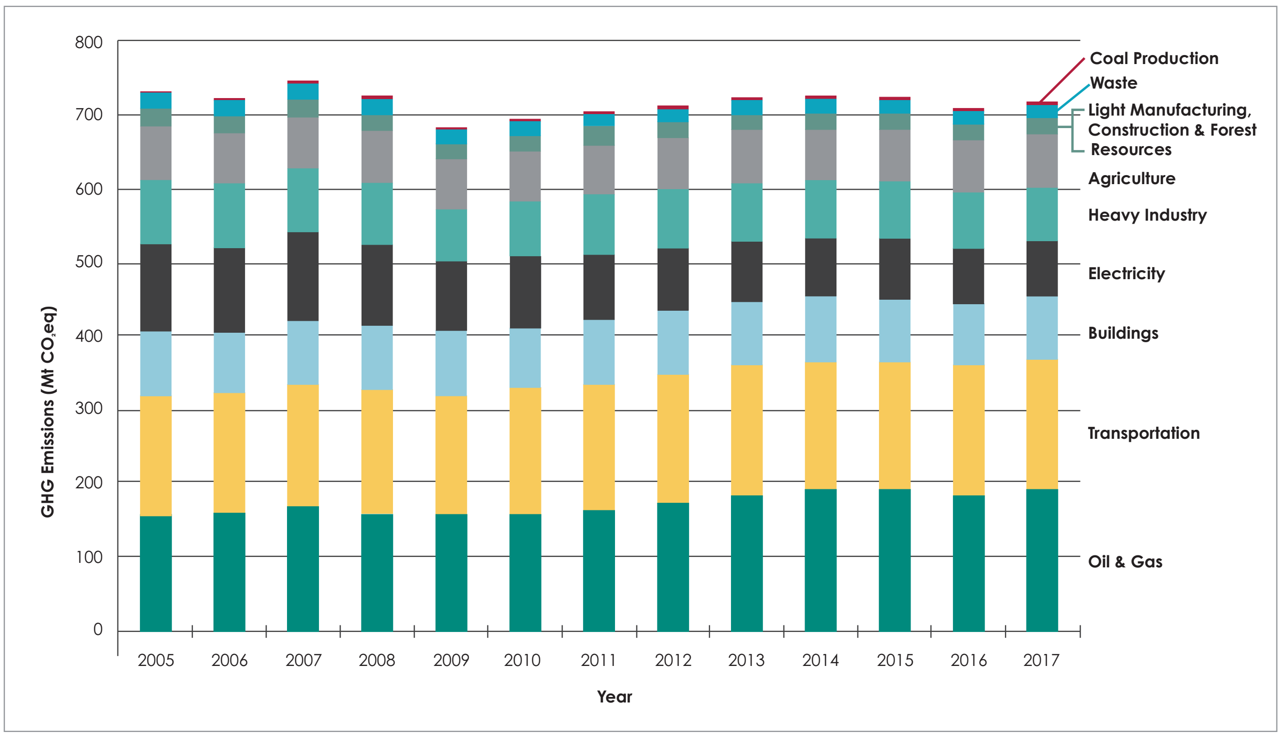


Figure 2. 2: Trends in Canadian GHG Emissions by Economic Sector, excluding LULUCF (2005–2017)
Source: National Inventory Report 1990-2017 – Greenhouse Gas Sources and Sinks in Canada

2.2 National Inventory Arrangements

Environment and Climate Change Canada is the single national entity with responsibility for preparing and submitting the National GHG Inventory to the UNFCCC and for managing the supporting processes and procedures.

The institutional arrangements for the preparation of the inventory include formal agreements on data collection and estimate development; a quality management plan, including an improvement plan; the ability to identify key categories and generate quantitative uncertainty analysis; a process for performing recalculations due to improvements; procedures for official approval; and a working archive system to facilitate third-party review.

Canada's inventory arrangements have not changed since the submission of its Third Biennial Report.

Submission of information regarding the national inventory arrangements, including details on institutional arrangements for inventory preparation, is also an annual requirement under the UNFCCC reporting guidelines on annual inventories (see Chapter 1, Section 1.2 of Canada's 2019 National Inventory Report).

More information on Canada's GHG Inventory is available at www.canada.ca/ghg-inventory.

3.0 ECONOMY-WIDE EMISSION REDUCTION TARGET

3.1 Canada's Emissions Reduction Targets

Under the 2015 Paris Agreement, Canada has committed to reduce its GHG emissions by 30% below 2005 levels by 2030. Under the 2009 Copenhagen Accord, Canada committed to reduce its emissions by 17% below 2005 levels by 2020 (Table 3.1).

Table 3.1: Canada's emission reduction targets

Target year	Base year	% reduction	Mt target	Established
2020	2005	17%	606	Copenhagen Accord
2030	2005	30%	511	Paris Agreement

Canada's GHG emission reduction targets are economy-wide, covering all sectors and gases. Global warming potential values for all covered gases are those established in the IPCC 4th Assessment Report. In addition to reporting information by IPCC sector, Canada also reports information on historical and projected emissions according to the following economic sector categories: electricity, transportation, oil and gas, heavy industry, buildings, agriculture, and waste and others (Table 3.2). This sectoral categorization allows for a better understanding of emissions as they relate to economic trends and policies in Canada, and is developed by reallocating the relevant proportion of emissions from various IPCC subcategories.

Additional information on the IPCC and economic sector definitions, as well as a detailed cross-walk between IPCC and Canadian economic sector categories can be found in Table A10-3 of Part 3 of Canada's 2019 National Inventory Report submission to the UNFCCC.

Table 3.2: Gases and Sectors Covered

Gases	IPCC Sectors	Economic Sectors
CO2	Energy	Oil and Gas
CH4	Transportation	Electricity
N2O	Industrial Processes	Transportation
HFCs	Agriculture	Heavy Industry
PFCs	Waste	Buildings
SF6	LULUCF*	Agriculture
NF3		Waste and Others
		LULUCF*

*LULUCF=Land Use, Land-Use Change and Forestry.

3.2 Approach to the Land Use, Land-Use Change and Forestry (LULUCF) Sector

Canada's Nationally Determined Contribution (NDC), submitted in May 2017, noted that Canada was examining its approach to accounting in the LULUCF sector towards its 2030 emission reduction target. It also indicated that Canada would exclude the impacts of natural disturbances and use a production approach to accounting for harvested wood products. This approach applies to Canada's 2020 emission reduction target as well. Canada's Third Biennial Report, submitted in December 2017, noted that work was continuing to develop LULUCF estimates that focus on anthropogenic emissions and removals as a basis for improved reporting and accounting for LULUCF.

Canada has since completed its analysis of the LULUCF sector and established accounting approaches for each of the LULUCF sub-sectors. For almost all sub-sectors, the accounting approach compares net emissions in a given year with net emissions in the base year (often referred to as a "net-net" approach). Given the unique characteristics of forests, which are significantly impacted by the effects of past management and natural disturbances, Canada uses a reference level approach for forest land remaining forest land and the associated harvested wood products. For detailed information on Canada's approach to LULUCF, please refer to Annex 2.6.

3.3 Approach to Market-based Mechanisms

Canada is committed to working with Parties under the Paris Agreement to establish robust Article 6 guidance that ensures environmental integrity and rigorous accounting rules that result in real reductions, in order to foster credible and efficient international carbon markets.

Canada's NDC, submitted in May 2017, noted that Canada would explore the use of internationally transferred mitigation outcomes (ITMOs) in the overall effort to achieve its 2030 NDC target, subject to the establishment of robust systems that deliver real and verified emissions reductions. As identified in the 3rd Biennial Report, Canada continues to examine its approach to the use of ITMOs, and Canada's federal government will continue to work with interested provinces and territories, as well as with international partners, to ensure that allowances acquired through international-emissions trading are counted towards Canada's international targets. This will take into account the applicable guidance under the UNFCCC and the Paris Agreement as well as other relevant input and programs (e.g., the International Civil Aviation Organization's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)).

The province of Québec remains a participant in the Western Climate Initiative (WCI) along with the State of California. The WCI is working to finalize its approach to accounting for emission reduction flows between jurisdictions under its shared cap-and-trade program.

4.0 CANADA'S PROGRESS IN ACHIEVING ITS QUANTIFIED ECONOMY-WIDE EMISSION REDUCTION TARGET

4.1 Context

Since Canada's last Biennial Report, federal, provincial, and territorial governments have continued to implement actions to fight climate change. These actions include measures aimed at reducing greenhouse gas emissions (GHGs) such as regulations, programs, and funding in all sectors of the economy including electricity, transportation, oil and gas, buildings, waste, agriculture, and forestry. These actions will continue to support Canada's transition towards a low-carbon future.

Canada is a decentralized federation, and addressing climate change is an area of shared jurisdiction, requiring actions across federal, provincial and territorial governments. Federally, the Minister of Environment and Climate Change Canada leads on Canada's climate change policies.

4.2 National Climate Change Plan

Following the adoption of the Paris Agreement in December 2015, Canada developed the first climate change plan in its history to include joint and individual commitments by federal, provincial and territorial levels of government and to have been developed with input from Indigenous Peoples, businesses, nongovernmental organizations, and Canadians from across the country. The Pan-Canadian Framework on Clean Growth and Climate Change (the Pan-Canadian Framework) was adopted by Canadian First Ministers (the Prime Minister and provincial and territorial premiers[2]) on December 9, 2016.

The Pan-Canadian Framework is built on four pillars: pricing carbon pollution, complementary actions to reduce emissions across the economy, adaptation and climate resilience, and clean technology, innovation, and jobs. It includes more than fifty concrete actions that cover all sectors of the Canadian economy.

The Pan-Canadian Framework includes an oversight and reporting process to assess progress toward the 2030 GHG target over time, and to explore opportunities to further enhance ambition consistent with commitments under the Paris Agreement. As part of the commitment to oversight and reporting, a synthesis report on the progress of the implementation of the Pan-Canadian Framework is developed and delivered annually to First Ministers and Canadians. The Second Annual Synthesis Report on the Status of Implementation was published in December 2018 and the third report is expected in early 2020. This work is described in more detail in Chapter 7.

More details on the Pan-Canadian Framework, its development, governance oversight, and reporting can be found in Canada's Seventh National Communication and Third Biennial Report, published in 2017.

4.3 Legislative Instruments

The federal *Canadian Environmental Protection Act* (CEPA, 1999) is the primary legal instrument enabling the Government of Canada to take action to protect the environment and human health in order to contribute to sustainable development. The Act

2 Saskatchewan and Manitoba did not adopt the Pan-Canadian Framework at the time. Manitoba has since joined (in February 2018). Although Saskatchewan did not adopt the Pan-Canadian Framework, the province continues to contribute to the annual synthesis report on progress in implementing the Framework.

includes authorities for the federal government to regulate various aspects related to releases of GHGs, including setting the quantity or concentration of a GHG that may be released from various types of facilities, or from vehicles, engines, and equipment.

Through its implementation of the Pan-Canadian Framework, the Government of Canada has finalized new or amended regulations under CEPA that will continue progress reducing GHGs from sectors including electricity and transportation. Examples include the *Regulations Amending the Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations*, *Regulations Limiting Carbon Dioxide Emissions from Natural Gas-fired Generation of Electricity*, and *Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations*.

The federal *Greenhouse Gas Pollution Pricing Act* received Royal Assent on June 21, 2018. This Act enables the implementation of a federal “backstop” carbon pollution pricing system and ensures that carbon pollution pricing with increasing stringency applies broadly to emissions sources in all jurisdictions in Canada.

Provinces and territories have also adopted legal instruments providing them with the necessary authorities to address environmental and climate change issues, in accordance with their unique jurisdictional responsibilities.

4.4 Domestic Institutional Arrangements

Fundamentally, Canada’s domestic institutional arrangements have remained the same since the last Biennial Report.

Collaboration with Indigenous Peoples

Following the joint commitments made by the Prime Minister and the National Leaders of the Assembly of First Nations, Inuit Tapiriit Kanatami and the Métis National Council, the Government of Canada collaborated with First Nations, Inuit, and the Métis Nation to establish three distinctions-based senior bilateral tables based on the robust, ongoing and meaningful engagement based on recognition of rights, respect, co-operation, and partnership. These tables have helped foster a collaborative approach to ongoing engagement with Indigenous Peoples and have helped support Indigenous climate leadership. In addition to these three tables, the Government of Canada continues to work to better support Indigenous Peoples as leaders to advance their self-determined priorities and plans within the context of national and global efforts to address the impacts of climate change, reduce the carbon footprint, and move towards energy sustainability.

Intergovernmental Collaboration

Longstanding mechanisms to support inter-jurisdictional coordination on environmental policies also continue to play a key role in the implementation of the Pan-Canadian Framework, including federal, provincial, and territorial ministerial councils and tables such as the Canadian Council of Ministers of the Environment (CCME). In addition to supporting implementation of the Pan-Canadian Framework, the CCME promotes collaborative actions by governments to advance shared climate change objectives, and undertakes studies and analysis to develop best practices and recommendations to enhance governments’ climate action.

4.5 Mitigation Actions and Their Effects

This section provides an update on Canada’s key policies and measures. Within this section, the description of policies are organized by economic sector beginning with key federal policies and measures, followed by provincial measures and territorial measures. Cross-cutting measures are described first, followed by measures by economic sector. Priority has been given to those policies and measures that have the most significant impact on sectoral GHG emissions. Comprehensive tabular information on these policies and measures, including projected mitigation impacts where available, is provided in Annex 1. Further information on GHG emission trends and projections can be found in Chapters 2 and 5, respectively.

4.5.1 Cross-Cutting Measures

Measures in this section include those aimed at reducing emissions across the economy or across multiple sectors. These measures include carbon pollution pricing, the clean fuel standard, as well as funding programs for green infrastructure, clean energy and energy efficiency, and clean technology.

Federal carbon pollution pricing

In October 2016, Prime Minister Trudeau announced the Pan-Canadian Approach to Pricing Carbon Pollution (the federal stringency requirements). This gave provinces and territories the flexibility to develop their own carbon pollution pricing systems, and outlined stringency criteria that provincial and territorial systems must meet. Its goal is to ensure that carbon pricing applies to a broad set of emission sources throughout Canada with increasing stringency over time to reduce GHG emissions and to support innovation and clean growth.

Federal carbon pricing system

Pursuant to the *Greenhouse Gas Pollution Pricing Act*, adopted on June 21, 2018, the federal carbon pollution pricing system has two components: a regulatory charge on fossil fuels (fuel charge) and a trading system for large industry, also known as the Output-Based Pricing System (OBPS).

The federal carbon pollution pricing system applies in any jurisdiction that requested it or that did not implement its own system that meets the federal stringency requirements. All direct proceeds raised from the federal carbon pollution pricing system are being returned to the province or territory where they were generated. The federal OBPS took effect on January 1, 2019 in Ontario, New Brunswick, Prince Edward Island, Manitoba, and partially in Saskatchewan. It took effect in Yukon and Nunavut on July 1, 2019.

In April 2019, the federal fuel charge took effect in Ontario, New Brunswick, Manitoba, and Saskatchewan, and in Yukon and Nunavut in July 2019. The federal fuel charge will apply in Alberta as of January 2020 and stand down in New Brunswick as of April 1, 2020.

All direct proceeds from the federal carbon pollution pricing system are returned to the jurisdiction of origin. In jurisdictions that opted for the federal system (Prince Edward Island, Yukon, and Nunavut), all direct proceeds from the federal system are being returned directly to the respective provincial or territorial government. In jurisdictions that did not commit to pricing carbon pollution, the bulk of direct proceeds from the federal fuel charge are being returned directly to individuals and families in those jurisdictions through Climate Action Incentive payments. The remainder of direct fuel charge proceeds are also being returned to the jurisdiction of origin through the Climate Action Incentive Fund.

Direct proceeds from the federal OBPS will also be returned to the jurisdiction of origin. Canada published a discussion paper in June 2019 on the use of direct proceeds from the OBPS for input. These proceeds will start to be collected in late 2020.

> **CLIMATE ACTION INCENTIVE FUND**
>
> The Climate Action Incentive Fund is a new federal program. In each province that does not meet the federal stringency requirements, the direct proceeds from the federal regulatory charge on fuel – that are not returned directly to individuals and families through Climate Action Incentive payments – provide support to schools, hospitals, small and medium-sized businesses, colleges and universities, municipalities, not-for-profits, and Indigenous communities in the province.

Provincial and territorial carbon pollution pricing systems

Every jurisdiction across Canada has committed to take action to reduce GHG emissions. A number of jurisdictions continued to refine their carbon pollution pricing systems in 2019. British Columbia increased the rate of its carbon tax from \$35 to \$40 per tonne of carbon dioxide equivalent (tCO_2e). New revenues generated from increasing British Columbia's carbon tax are used to protect affordability for low-income families in the province and support industry competitiveness. Opt-ins[3] for Québec's cap-and-trade system began as planned in January 2019, and by the end of the year, Québec and California will have held 21 joint auctions through the Western Climate Initiative.

Alberta has had regulations pricing GHG emissions at large regulated facilities in place since 2007. These regulations were updated with the announcement of Alberta's TIER regulation in October 2019, which will come into force as of January 1, 2020. The TIER regulation includes continuation of both the generation of emission offsets for use by regulated facilities through the Alberta emission offset system, and continuation of a technology fund at $30 per tonne in 2020 as a compliance mechanism.

Some jurisdictions implemented new initiatives related to carbon pollution pricing. Nova Scotia launched its cap-and-trade program in January 2019, and will hold its first auction of GHG emissions allowances in 2020. Saskatchewan implemented sector-specific output-based performance standards on large industrial emitters. Prince Edward Island began administering its carbon levy in April 2019. Newfoundland and Labrador introduced its carbon pricing system on January 1, 2019. It consists of a carbon tax on transportation, building and related fuels and a performance standard approach for large industry and large-scale electricity generation. Ontario has developed an Emissions Performance Standards (EPS) program to regulate GHG emissions from large emitters. Ontario's EPS is a regulatory approach that establishes GHG emissions performance standards that facilities are required to meet or use compliance units for GHG emissions in excess of the standard. The purpose of the EPS regulation is to reduce GHGs in the industrial sector and to provide flexibility for Ontario circumstances. Compliance obligations would apply for the first time in the year the federal government removes Ontario from Part 2 of Schedule 1 of the *Greenhouse Gas Pollution Pricing Act*, if the federal government makes that decision.

Other federal, provincial, and territorial carbon pollution pricing-related initiatives

Canada is also developing a federal GHG offset system as a compliance mechanism for the OBPS. As announced in Budget 2019, the Government of Canada is developing a federal GHG offset system to encourage cost-effective domestic GHG emissions reductions or removal enhancements from activities that are not covered by carbon pollution pricing, in sectors such as forestry, agriculture and waste. The federal GHG offset system will build on the recommendations in the Pan-Canadian GHG Offsets Framework for the design of offset systems agreed to by the Canadian Council of Ministers of the Environment in November 2018. In summer 2019, the federal government published a discussion paper to seek input on key system design elements.

Saskatchewan has also begun development of a provincial GHG offset program to help large industrial emitters in the province meet their regulated performance standards.

Low Carbon Economy Fund

The Government of Canada's $2 billion Low Carbon Economy Fund is an important part of Canada's climate plan. It was developed to support the implementation of the Pan-Canadian Framework by leveraging investments in projects that will generate clean growth and reduce GHG emissions towards meeting Canada's commitments under the Paris Agreement (i.e. 30% reduction in GHG emissions below 2005 levels by 2030). The Low Carbon Economy Fund is split into two parts, the Leadership Fund and the Challenge. Combined, the two parts of the Low Carbon Economy Fund support projects that help:

- Make homes and buildings more efficient;
- Companies innovate and access technologies to reduce their emissions and grow sustainably; and,
- Support the forest and agriculture sectors to enhance stored carbon in forests and soils.

The Leadership Fund provides up to $1.4 billion to provinces and territories to promote investments in initiatives to encourage clean growth and GHG emission reductions. Through the Leadership Fund, the Government of Canada has entered into 11 agreements with provinces and territories investing in 48 projects representing approximately $1 billion and estimated emissions reductions of approximately 3.4 Mt

3 Opt-ins in this context refers to voluntarily choosing to become a regulated entity in order to participate in a carbon pricing system.

of CO_2e in 2030. These investments help address the specific priorities of the provinces and territories while furthering the goals of the Pan-Canadian Framework.

The Challenge provides over $500 million to support projects that leverage ingenuity to reduce emissions and generate clean growth. Through the two streams of the Challenge, the Champions stream and the Partnerships stream, the Government of Canada is partnering with provinces and territories, municipalities, Indigenous communities and organizations, small- and medium-sized businesses, and not-for-profit organizations to support projects that create good jobs for Canadians, deliver clean growth, support innovation, and save money. The Government of Canada is currently working to complete funding agreements across Canada to provide over $414 million to 96 projects representing a reduction in emissions of approximately 2.4 Mt of CO_2e in 2030.

A total of 307 projects have been approved and funded under the Low Carbon Economy Fund. Examples of specific projects funded through the Low Carbon Economy Fund are referenced in the relevant sector-specific sections of this chapter, as well as in Annex 1.

Clean Fuel Standard

The Clean Fuel Standard aims to lower the carbon intensity of fossil fuels resulting in significant GHGs emissions reductions, while sending a market signal for investment and innovation in low carbon fuels and technologies and reducing compliance costs on industry through a flexible regulatory design. The Clean Fuel Standard will cover three fuel classes: liquid fuels (e.g., gasoline, diesel) used mainly in transportation, as well as gaseous fuels (e.g., natural gas) and solid fuels (e.g., petcoke) used mainly in industry and buildings. Based on stakeholder feedback, a phased approach is being adopted, with the liquid fuel regulations developed first, followed by gaseous fuel and solid fuel regulations. In June 2019, the Government of Canada released a *Proposed Regulatory Approach for the Clean Fuel Standard*, presenting a detailed proposed regulatory design for the liquid fuel class regulations. The *Proposed Regulatory Approach* builds on extensive stakeholder consultation since 2016.

Phase-down of HFCs

Canada has acted as a strong advocate for a global phase-down of hydrofluorocarbons (HFCs) and was one of the first countries to ratify the Montreal Protocol on Substances that Deplete the Ozone Layer. Following publication of final regulations to phase down HFCs, Canada ratified the Kigali Amendment in November 2017, helping to bring the amendment into force on January 1, 2019. The amendment commits countries to significant reduction of consumption and production of HFCs, minimizing their impact on climate change. In April 2018, federal regulations to phase down the consumption of HFCs came into effect. These regulations aim to reduce the supply of HFCs that enter Canada and the demand for HFCs in manufactured products. In accordance with the Kigali Amendment, Canada began the phase-down of consumption and production of HFCs with 10% reduction in January 2019.

Energy Efficiency

During 2018 and 2019, the federal government made three regulatory amendments to update or introduce minimum energy efficiency standards for 35 equipment and appliance product categories, for a total of nearly 50 product categories covered since 2016. For example, in October 2018, the Government of Canada published an amendment to the *Energy Efficiency Regulations*, putting in place new energy efficiency standards for equipment and appliances in residential and commercial settings, and on June 12, 2019, the Government of Canada finalized two more amendments to the *Energy Efficiency Regulations*. In addition, the Federal Energy Efficient Equipment and Appliances Program also works with provincial and territorial governments and industry stakeholders to encourage market transformation in three equipment areas: windows, space heating and water heating.

Provincial and territorial energy efficiency measures as they relate directly to buildings are discussed in the Buildings Sector section below.

Investing in clean technology, green infrastructure, and clean energy

To help clean technology firms grow, the Government of Canada committed $1.4 billion in new financing in 2017 through the Business Development Bank of

Canada (BDC) and Export Development Canada (EDC). This financing includes $950 million in growth capital to support clean technology producers ($700 million by BDC and $250 million by EDC). It also includes approximately $450 million to EDC in additional project financing for “first of its kind commercial scale” clean technology projects. EDC has approved one project under this financing, and is working to approve additional clean technology projects. To mobilize its allocated financing, BDC launched its Cleantech Practice in 2018 to support the growth and expansion of future Canadian global technology companies. The Cleantech Practice helps high-potential clean technology firms expand by providing them with the capital they need to hire new staff, develop products, support sales, and scale up and compete globally.

The Government of Canada has also provided funding to a number of other clean technology related programs, including $400 million in 2017 to recapitalize Sustainable Development Technology Canada (SDTC)’s Sustainable Development Tech Fund. SDTC subsequently approved 62 new projects designed to develop and demonstrate new clean technologies that promote sustainable development.

The Government of Canada continues to invest in technology research and development, through the Energy Innovation Program, to promote clean technology and clean energy adoption in buildings, industry, electricity and transportation. This program is designed to deliver long-term reductions in GHG emissions and support energy sector competitiveness as Canada transitions to a low-carbon economy. To date the Energy Innovation Program has supported 63 external grants and contribution projects and 60 federal projects focused on addressing innovation gaps and opportunities to reduce GHGs in key areas such as renewable energy, smart grids, energy-efficient buildings, carbon capture use and storage, and cleaner production of oil and gas.

Additionally, in collaboration with Breakthrough Energy, led by influential global investors including Bill Gates, the Government of Canada launched Breakthrough Energy Solutions Canada. This first-of-its kind initiative will provide up to $40 million to help Canadian firms with low-carbon solutions commercialize their technologies to reach global and domestic markets.

Through the new Canada Infrastructure Bank (CIB), which has a mandate to invest in revenue-generating infrastructure projects that are in the public interest, $5 billion has been made available for green infrastructure projects, including those that reduce GHGs emissions, deliver clean air and safe water systems, and promote renewable power. Between July and October 2019, CIB continued to engage with public sponsors across the country; provide advice on infrastructure projects; develop investment opportunities; and announce project commitments.

In addition, the Green Infrastructure-Climate Change Mitigation stream of the Investing in Canada Infrastructure Program is investing at least $3.8 billion of its $9.2 billion funding envelope in projects that increase generation of clean energy, increase capacity to manage more renewable energy, improve the energy efficiency of eligible buildings, and increase access to clean energy transportation and reduce reliance on diesel in rural and remote communities.

Under Impact Canada’s Clean Technology stream, the Government of Canada has launched six clean technology prize challenges which aim to unlock breakthrough solutions to the complex problems of decarbonizing aviation, modernizing power grids, designing better batteries, reducing energy use in mining, increasing the participation of women in the clean technology sector, and reducing reliance on diesel among northern and remote communities. This includes $20 million for an Indigenous Off-Diesel Initiative to achieve a breakthrough in reducing diesel in remote Indigenous communities. The Indigenous Off-Diesel Initiative provides hands on support and funding to 15 Indigenous remote communities to develop ambitious community-driven clean energy plans and break ground on their first clean energy projects.

Provinces and territories are also investing in innovation and clean energy initiatives. For example, through the CleanBC Program for Industry, a portion of British Columbia’s carbon tax paid by industry is redirected into incentives for cleaner operations and a fund to support industry investments in projects to reduce emissions from large industrial operations in the province. Ontario is proposing to launch an emission reduction fund to encourage private investment in clean technology solutions. SaskPower, the main supplier of electricity in Saskatchewan is a leader in implementation and demonstration of carbon capture and storage technology, and is home to the world's largest carbon capture and storage demonstration site—the Weyburn-Midale project.

In 2019, the Northwest Territories launched the GHG Grant Program that provides fiscal support to recipients including Indigenous, municipal and territorial governments, businesses, non-profits, and individual building owners, who implement energy efficiency projects that reduce GHG emissions in the territory. In 2018, Nunavut introduced new heating systems in Sanikiluaq and Taloyoak, which capture residual heat from power generation and funnel the heat to local commercial and institutional buildings; this project also reduces energy costs for customers and will extend the life of heating equipment.

CLEAN GROWTH HUB

The Clean Growth Hub was launched in January 2018 as a whole-of-government focal point for clean technology to help stakeholders navigate federal programs and services most relevant to their needs. More than 1,200 entrepreneurs have sought this service to date. In addition to helping stakeholders identify programs, the Clean Growth Hub leverages existing knowledge, expertise and relationships across the Government of Canada to improve collaboration and program coordination. As part of the Clean Technology Data Strategy, the Clean Growth Hub continues to improve the federal capacity to track clean technology outcomes by ensuring consistency and quality of data collected by federal programs.

Greening government operations

Canada is committed to leading by example on greening government operations and growing demand for cleaner solutions, and has set an ambitious target to reduce GHG emissions from federal facilities and fleets by 40% below 2005 levels by 2030, and by 80% below 2005 levels by 2050. A commitment to green procurement and life-cycle assessment principles is also an essential part of the initiative, including using 100% clean electricity by 2025 and incorporating criteria in procurement that address carbon reduction, sustainable plastics and broader environmental benefits for goods and services that have a high environmental impact. As a result of ongoing efforts in this area, GHG emissions have already been reduced by 32% compared with the 2005 baseline.

Among the provinces and territories, British Columbia has been a leader in greening government operations for nearly a decade; the province has achieved carbon neutrality for its public sector operations every year since 2010. Prince Edward Island is also working to implement a greening government program, including energy efficiency upgrades to provincial buildings, improved fuel efficiency of its vehicle fleet, and a commitment to green procurement. Newfoundland and Labrador has a similar plan that includes increased waste diversion, while Manitoba is also taking action on government leadership by establishing a Low Carbon Government Office.

4.5.2 Electricity Sector

Approximately 82% of Canada's electricity comes from non-emitting sources, making it one of the cleanest electricity systems in the world. Canada continues to further reduce GHG emissions in this sector through a number of actions. As Canada makes steady progress in reducing emissions from its electricity sector, some provinces and territories already have nearly completely non-emitting electricity systems, including Yukon, Newfoundland and Labrador, Prince Edward Island, Manitoba, British Columbia, and Québec.

Reducing emissions from coal-fired generation of electricity

In December 2018, the Government of Canada finalized *Regulations Amending the Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations*, which accelerates Canada's reduction of GHG emissions from electricity generation by phasing out traditional coal-fired electricity by 2030.

Across Canada, jurisdictions have made progress on reducing reliance on coal-fueled electricity. In 2018, 93% of Ontario's electricity generation was produced from emissions-free sources, as coal-fired electricity was eliminated from all Ontario Power Generation stations in 2014.

In 2019, Saskatchewan and Nova Scotia signed equivalency agreements with the federal government to reduce emissions from coal-fired electricity. Under the *Canadian Environmental Protection Act, 1999*, the federal government may negotiate equivalency agreements with provinces that have regulations which achieve equal or better emission-reduction outcomes compared to the federal regulations. These agreements establish conditions under which the federal regulations would not apply, and provincial regulations would apply instead.

Strategic interconnections

Electricity grids also cross provincial and international borders, and clean electricity is being exported from some provinces to displace reliance on fossil-fuel based generation. For example, Manitoba is constructing the Keeyask generating station, which will add 695 megawatts of renewable electricity capacity in the province by 2021, with its first generator expected to go into service in October 2020. The increase in exported electricity will help reduce GHG emissions in neighbouring provinces and states.

Canada continues to explore the possibility of new cross-provincial strategic interconnections of electricity grids that transmit energy to provinces and regions seeking to reduce reliance on fossil fuels. This would deliver clean electricity to places that need it and support additional emission reductions from the electricity sector. These strategic interconnections will increase Canada's capacity to generate and manage renewable energy. Provinces and territories can elect to use the $9.2 billion Green Infrastructure funding envelope under the Investing in Canada Infrastructure Program to support such projects. Canada's Regional Electricity Cooperation and Strategic Infrastructure Initiative brought together the four western provinces, the Northwest Territories, and the four Atlantic provinces and their utilities to identify and assess the best regional electricity infrastructure projects that can significantly reduce GHG emissions. Final reports were published in summer 2018 and governments and utilities continue to advance projects identified to significantly reduce GHG emissions and have economic merit.

Federal Limits on Natural Gas-Fired Electricity Emissions

In December 2018, the Government of Canada also published *Regulations Limiting Carbon Dioxide Emissions from Natural Gas-fired Generation of Electricity*, which came into effect on January 1, 2019. These regulations work in tandem with the coal regulations to ensure that where coal-fired electricity is replaced with natural gas-fired electricity generation, the new systems use efficient technology. The regulations set performance standards to control carbon dioxide emissions for new units and units converted from coal to run on gas electricity generation in Canada.

Smart Grid Program

Canada's Smart Grid program, introduced in 2018, commits up to $100 million in funding for the demonstration of promising, near commercial smart grid technologies and the deployment of integrated smart grid systems. The program seeks to accelerate the transition to a clean growth economy by better utilizing the existing capacity of electricity assets, increasing the penetration of renewable generation, and increasing the reliability and resiliency of the power system while maintaining cyber security and reducing GHG emissions. Twenty projects have been selected to receive funding under this program.

Emerging Renewables

The Emerging Renewable Power program will provide up to $200 million to expand the portfolio of commercially viable renewable energy sources and technologies available to provinces and territories as they work to reduce GHG emissions from their electricity sectors. Selected projects include instream tidal, solar and geothermal energy technologies.

Reducing reliance on fossil fuels in Indigenous, northern and remote communities

To reduce reliance on diesel, federal funding has been announced to support new programs, including for renewable energy. Program activities include deployment of new renewable energy technologies, demonstration of innovative clean energy solutions, support for the development of bioheating projects, and capacity building.

Under the Investing in Canada Plan, the Clean Energy for Rural and Remote Communities program provides up to $220 million in funding for renewable energy projects in rural and remote communities to reduce their reliance on diesel and other fossil fuels. Funding for more than 70 projects was allocated through two funding streams targeting projects and capacity building.

While the primary focus of the $400 million Arctic Energy Fund under the Investing in Canada Infrastructure Program is to improve energy security, funding can also be used to support the transition, in whole or in part, from fossil fuel-based systems to renewables.

Nunavut's utility, the Qulliq Energy Corporation (QEC), is in the process of developing an Independent Power Producer (IPP) Program. Through the program, the QEC will promote energy production by an IPP by providing funding support the equivalent of what the diesel would have cost.

Improving efficiency and increasing renewable energy

Provinces and territories are working to promote renewable energy and increase energy efficiency. In Saskatchewan, SaskPower has set a target to achieve up to 50% of its generation capacity from renewable sources by 2030, including the addition of 60 megawatts of solar generation by 2021 and up to 1,600 megawatts from wind by 2030. Nova Scotia's *Electricity Efficiency and Conservation Restructuring Act* (2014) requires Nova Scotia Power to purchase efficiency resources whenever they are lower cost than producing power. In Prince Edward Island, the PEI Energy Corporation has begun work on the first of two new wind farms, expected to generate 30 megawatts of power in 2020 and 40 megawatts by 2026. Building on the Muskrat Falls hydroelectric development, which will reduce GHG emissions in Newfoundland and Labrador by approximately 10% once operational, Newfoundland and Labrador announced a renewable energy strategy in 2019 that will, among other items, increase capacity and demand for renewable electricity in isolated diesel systems in the province's northern, remote and Indigenous communities. Also implemented in 2019, Yukon's Independent Power Production Policy enables independent, non-utility electricity producers to sell electricity to Yukon's two public utilities through renewable energy technologies, such as wind power, micro-hydro, biomass and solar electric systems. As of July 2019, the program has approved three projects, the first of which is expected to be operational by mid-2020.

GENERATION ENERGY

In 2017 Canada launched Generation Energy, a dialogue about Canada's energy future. Over 380,000 Canadians participated, including through targeted sessions that brought together Indigenous Peoples, women, students, industry and academics. As part of the dialogue, the Generation Energy Council was established. Their report, released in June 2018, identified pathways that could collectively lead to the affordable, reliable and sustainable energy future desired by Canadians. This work served as the foundation for a vision for Canada's energy future announced at the 10th Clean Energy Ministerial and 4th Mission Innovation meetings hosted by Canada in May 2019. The advice continues to inform Canada's path to a clean energy future through saving energy, powering clean communities, using more renewable fuels, and powering the world.

4.5.3 Transportation Sector

Setting Emissions Standards and Improving Efficiency

Transportation is one of the largest sources of GHGs in Canada, accounting for about 24% of all emissions in 2017.

With respect to heavy-duty vehicles, the Government of Canada continues to implement the *Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations* that set performance-based GHGs emission standards for new on-road heavy-duty vehicles (such as highway tractors, buses and dump trucks) and their engines made in 2014 and later years. On May 30, 2018, the Government of Canada published Amendments to these Regulations. These Amendments establish more stringent GHGs emission standards that begin with the 2021 model year for on-road heavy-duty vehicles and engines.

With respect to light-duty vehicles (e.g., passenger vehicles), the Government of Canada continues to implement emission standards for new vehicles. The *Passenger Automobile and Light Truck Greenhouse Gas*

Emission Regulations establish progressively more stringent GHG standards for new light-duty vehicles of model years 2011 to 2025.

Manitoba announced it would increase its mandated biofuel content to 10% for gasoline and to 5% for diesel in 2020. Ontario is amending its *Technical Standards and Safety Act* to reduce burden on business and allow for the expanding of 24/7 compressed natural gas refueling stations for trucks along Ontario's 400 series highways. In British Columbia, a program beginning in 2020 is set to increase production of renewable gasoline and diesel by 650 million litres by 2030, making up 8% of provincial total annual fuel use. British Columbia is also greening the transportation sector through the announcement of increased tailpipe emissions standards for vehicles sold after 2025.

Investing in Infrastructure

To expand and upgrade public transit, the Investing in Canada Plan has put forward $28.7 billion for public transit projects across the country that will create more affordable transportation options, mitigate climate change and reduce traffic congestion and air pollution. For example, the City of Ottawa, Ontario, expects the first phase of its Light Rail Transit Project to reduce GHG emissions by close to 100,000 tonnes per year by 2030, the equivalent of taking 25,000 cars off the road. Ontario is also making the single largest capital investment in new subway builds and extensions in Ontario's history through the "New Subway Transit Plan for Greater Toronto and Hamilton Area", continuing expansion of its GO rail network, and will continue to provide financial support for municipal transit programs across the province.

As part of the Public Transit Infrastructure Fund introduced in Budget 2016, the federal government has approved over $3.4 billion in funding for 1,194 projects across Canada. To date, over $1.2 billion in funding has been disbursed, and nearly all approved projects are underway.

Through the National Trade Corridors Fund, which was launched in 2017, the Government of Canada is investing $2.4 billion over 11 years to strengthen the efficiency and resilience of Canada's transportation system by addressing bottlenecks, adding capacity, and improving its ability to adapt to a changing climate. Since 2017, the Government of Canada has announced funding for 81 projects through three competitive calls for proposals, with a total cost of $3.6 billion and a federal investment of $1.7 billion.

Putting More Zero Emission Vehicles on the Road

The Pan-Canadian Framework indicated a commitment for federal, provincial and territorial governments to accelerate the adoption of zero-emission vehicles (ZEVs) in Canada. In January 2019, the Government of Canada set the following sales targets for ZEVs: 10% of new light-duty vehicle sales by 2025; 30% by 2030; and 100% by 2040. The Government of Canada recently announced in Budget 2019 $300 million for the creation of the Incentives for Zero-Emission Vehicles (iZEV) Program. The iZEV Program launched on May 1, 2019 and provides point-of-sale incentives of up to $5,000 on eligible ZEVs. To support business adoption of ZEVs, Budget 2019 also introduced a 100% tax write-off for eligible vehicles.

The Government of Canada is investing over $180 million in electric vehicle (EV) charging stations and other alternative refueling infrastructure, including demonstration and deployment projects for EV chargers, and alternative fuel stations along Canada's highways and freight corridors, removing a key barrier to Canadians' uptake of ZEVs and alternative fuel vehicles. As of March 2019, the Electric Vehicle Infrastructure Deployment Program had projects completed or underway for over 500 fast-charging stations, as well as natural gas and hydrogen stations, with more stations and requests for proposals on the way.

Additionally, federal funding of $130 million was announced in 2019 to deploy new recharging and refuelling stations in workplaces, public parking spots, commercial and multi-unit residential buildings, and remote locations, while $5 million was announced to support voluntary ZEVs sales targets and ensure that vehicle supply meets increased demand.

Many provinces are also implementing measures to support uptake of ZEVs through incentives and infrastructure. In May 2019, British Columbia passed legislation to phase in targets for the sale of ZEVs. This legislation sets targets of 10% ZEV sales by 2025, 30% by 2030, and 100% by 2040. In 2018, Québec adopted regulations to set new targets for sales of ZEVs. In 2019, New Brunswick continued to expand the reach of its charging network through the announcement of funding for seven new fast charging stations. Prince Edward Island has also committed to building a fast-charger network to be completed in 2019/2020. Newfoundland and Labrador has also committed to bringing fourteen fast-charging stations into the province's network.

CLEAN BC

In 2018 the Government of British Columbia released CleanBC, an action plan to put the province on the path to a cleaner, better future – with a low-carbon economy that creates opportunities for all while protecting clean air, land and water. The plan sets actions to improve energy efficiency in buildings and transportation, and has a goal that every new building constructed in B.C. will be "net-zero energy ready" by 2032. The plan accelerates British Columbia's shift to cleaner fuels, and helps industry to reduce emissions and air pollution. It also sets out a plan so that by 2040, all new cars sold in the province will be zero-emission vehicles.

4.5.4 Oil and Gas Sector

Federal measures to reduce methane emissions in the oil and gas sector

The oil and gas sector accounted for 26% of Canada's total GHG emissions in 2017 and is Canada's largest emitter of methane. The Government of Canada is committed to reducing methane emissions from the oil and gas sector by 40-45% from 2012 levels by 2025, and published regulations in April 2018, to support this goal. Some of the federal methane requirements begin to come into effect on January 1, 2020, with all requirements in effect by January 1, 2023. Newfoundland and Labrador is working with the federal government to adopt methane emissions regulations that recognize the unique management structure of the offshore petroleum industries in that province.

Other programs to reduce emissions

In 2019, British Columbia published provincial methane rules through amendments to their *Drilling and Production Regulation*, which come into effect in January 1, 2020 and will reduce methane emissions from upstream oil and gas operations. In addition, Alberta has finalized its Energy Regulator Directive 060 "Upstream Petroleum Industry Flaring, Incinerating, and Venting" and Directive 017 "Measurement Requirements for Oil and Gas Operations". These measures set requirements to reduce upstream oil and gas methane emissions by 45% relative to 2014 levels by 2025. Directive 060 will take effect as of January 1, 2020 and addresses the primary sources of methane emissions from Alberta's upstream oil and gas industry: fugitive emissions and venting; Directive 017 went into effect on December 13, 2018 and improves measurement, monitoring and reporting of methane emissions. In 2019, Saskatchewan released an action plan to reduce emissions by 40-45% by 2025, while introducing opportunities to capture and commercialize methane. Saskatchewan has also implemented new oil and gas emissions management regulations to reduce emissions while supporting innovative reduction technologies and allowing oil and gas operators to efficiently prioritize their emission reduction investments.

The Government of Canada has been undertaking equivalency discussions with interested provinces. Where a province or territory has regulatory requirements that achieve equivalent outcomes, an equivalency agreement can be considered. In 2019, Canada published a draft equivalency agreement with British Columbia, as well as a draft Order to stand down the federal regulations in that province, for public comment.

Canada has established the Strategic Innovation Fund (SIF), and in 2019, announced $100 million over four years to SIF, leveraging private sector co-investments, in order to support the activities of the Clean Resource Innovation Network. This Network, a consortium of businesses, innovators, not-for-profits, and academic institutions, is working to accelerate the development and adoption of innovative technologies and processes to lower the oil and gas industry's environmental impacts, including by reducing GHG emissions.

In addition, the Oil and Gas Clean Technology Program has provided $50 million over two years to support eight innovative, industry-led projects to develop and demonstrate cost-effective technologies that reduce GHG emissions from the oil and gas sector.

Under the Clean Growth program, the Government of Canada is providing $155 million over four years to co-fund 50 research, development, and demonstration projects in Canada's energy, mining, and forestry sectors through trusted partnerships with provinces and territories. The program is helping to accelerate emerging clean technologies toward commercial readiness, reduce environmental impacts, enhance competitiveness, and create jobs.

The Champions stream of the Low Carbon Economy Fund provides funding for oil and gas/energy projects aimed at reducing GHG emissions in these sectors. In March 2019, the Government of Canada announced $62.3 million in support for two projects to help improve the environmental performance of Canada's oil and gas sector.

4.5.5 Buildings Sector

Making buildings more energy efficient

Canada's federal government continues to work with provincial and territorial governments to support the development and adoption of increasingly stringent model building codes, with the goal that provinces and territories adopt a "net-zero energy ready" model building code by 2030. The Government of Canada is also pursuing the development of a new model code for existing buildings by 2022, and is working with provincial and territorial governments with the aim of requiring labelling of building energy use through the expansion of the federal government's existing benchmarking and labelling measures. Additionally, Canada is supporting the research, development, and demonstrations of net-zero energy ready technologies and practices to reduce the cost of high-performance buildings and drive adoption by the construction industry.

The Low Carbon Economy Fund also supports initiatives in the building sector, with 36 projects that support energy efficiency in the residential and commercial buildings and 33 projects that support energy efficiency in the industrial sector under the Leadership Fund and the Challenge. Some of the Leadership Fund projects are provincial and territorial programs that further redistribute funding to a large number of projects.

Increasing the use of wood for construction can reduce emissions as the carbon stored in that wood becomes locked in for a long period of time and can replace other, more emission-intensive building materials. Canada's Green Construction through Wood Program supports projects and activities that increase the use of wood as a greener building material in infrastructure projects, and began issuing funding for projects in 2019.

Provinces and territories have introduced various initiatives to make buildings more energy efficient. As of January 1, 2019, Saskatchewan began using the National Building Code and added provisions that improve energy efficiency standards for houses and small buildings. Ontario intends to review its building code and support the adoption of cost-effective energy efficiency measures, and is working on its next update to regulation 509/18, which sets out efficiency requirements for over 80 products using electricity, natural gas, and oil in residential, commercial and industrial sectors. The Northwest Territories, Prince Edward Island and Newfoundland and Labrador have expanded energy efficiency programs for residential and commercial buildings through the Low Carbon Economy Leadership Fund. In 2019, Prince Edward Island introduced four new biomass heating systems to regional public schools, and has plans to install six more in public buildings in 2020. New building codes will also take effect in Prince Edward Island and Québec in 2020, which will improve energy efficiency requirements for commercial, institutional, industrial and residential buildings. As of 2020, British Columbia will make residential natural gas consumption cleaner by putting in place a minimum requirement of 15% renewable gas content (e.g., generated from organic waste). In 2018, Manitoba established Efficiency Manitoba, a new Crown corporation with the sole purpose of administering and delivering energy savings cost-effectively to consumers. Efficiency Manitoba needs to meet legislated savings targets of 22.5% of domestic electricity demand (an average of 1.5% annually of domestic electricity consumption) and 11.25% of domestic natural gas demand (an average of 0.75% annually of natural gas consumption) over a 15-year period.

4.5.6 Heavy Industry Sector

To improve industrial energy efficiency in Canada, various energy management systems are being advanced such as ENERGY STAR for Industry, and a new version of ISO 50001 adopted in 2018.

British Columbia has started implementation of the CleanBC Program for Industry: i) the CleanBC Industrial Incentive Program opened to applications from industry and will promote cleaner industrial operations across the province by reducing carbon tax costs for facilities near world-leading benchmarks, and ii) the CleanBC Industry Fund, which supports industry investments that reduce GHG emissions from large industrial operations, opened its competitive application process in 2019. In January 2019, Alberta's Industrial Efficiency Challenge announced $69 million in funding for ten projects in energy-intensive and trade exposed industries to implement new technologies that reduce emissions and operating costs. Ontario regulatory changes have been developed for major-emitting industrial sectors that would help facilities use alternative, less carbon intensive fuels (such as biomass) in place of coal and petroleum coke.

4.5.7 Waste and Other Sector

Reducing emissions from waste

British Columbia recently augmented its landfill gas management strategy (which had already included a requirement to capture 75% of landfill gas). Changes to the provincial strategy included commitments to achieving 95% organic waste diversion. Implemented in 2018, Saskatchewan's Solid Waste Management Strategy promotes upgrading of municipal waste and sewage management services to reduce, capture and use GHG emissions and biogas that would otherwise be released into the air, by prioritizing these projects under joint federal/provincial funding programs.

The Pan-Canadian Framework identifies the municipal waste sector as a key source of cleaner fuels, such as renewable natural gas from landfills, and highlights federal-provincial-territorial work on generating bio-energy and bio-products as an emission reduction opportunity. Provinces including Québec and New Brunswick are already pursuing measures in this area. Québec recently updated its *Regulation Respecting the Landfilling and Incineration of Residual Materials*. New Brunswick is focused on reducing methane emissions from waste through its landfill gas management strategy. Six municipal solid waste landfills have installed approved landfill gas capture systems and five of the six landfills are generating electricity from the biogas.

Canada's most recent inventory report shows that at the national level in 2017, 43% of methane generated at municipal landfills was captured by landfill gas collection systems. As of December 2019, the Low Carbon Economy Fund has approved 15 projects targeting the waste sector. For example, funding for several projects that will generate bioenergy from waste found in city landfills across Canada were recently announced, including $10 million of funding to support five projects in Saskatchewan, Manitoba and Ontario related to landfill gas collection efficiency and technologies.

Reducing plastic waste and pollution

The Government of Canada is working with all levels of government, industry, non-government organizations, academia and Canadians to take action on plastic waste and pollution. In 2018, the federal government committed to eliminating the unnecessary use of single-use plastics in government operations, events and meetings, and diverting at least 75% of plastic waste from federal operations by 2030. In 2018, Canada also championed the Ocean Plastics Charter, which commits to a more resource-efficient and lifecycle approach to plastics stewardship, on land and at sea. At the provincial and territorial level, the Canadian Council of Ministers of the Environment approved a Canada-wide Strategy on Zero Plastic Waste in November 2018 that takes a circular economy approach to plastics and provides a framework for action in Canada. In June 2019, the first phase of this strategy was approved, which outlines government actions that will support implementation.

In June 2019, the Government of Canada announced efforts to drive ambitious actions with provincial and territorial governments and stakeholders across Canada, such as banning harmful single-use plastics as early as 2021, and working with provinces and territories to develop consistent extended producer responsibility programs so the same rules for collection and recycling apply to all companies that produce plastic products.

4.5.8 Agriculture Sector

Reducing emissions from agriculture

The Canadian Agricultural Partnership launched on April 1, 2018 for the period 2018-2021, and is a $3 billion investment that will strengthen the agriculture, agri-food and agri-based products sector, ensuring continued innovation, growth and prosperity. One of the objectives of the program is to reduce GHG emissions from the agricultural sector. Through the Partnership, provinces and territories design and manage delivery of environmental stewardship programs to support Environmental Farm Plans and adoption of best management practices such as cover crops, precision nutrient application, equipment for reduced tillage seeding and enhanced irrigation efficiency.

The Agricultural Clean Technology Program is a $25 million, three-year initiative (2018-2021) supporting investments made by provincial and territorial governments to lower GHG emissions from agricultural production through research, development and adoption of clean technologies for the agriculture sector through precision agriculture and agri-based bio-products.

Examples of provincial initiatives include Saskatchewan's Agriculture Water Management Strategy, which supports responsible drainage to reduce direct nitrous oxide emissions from agricultural runoff and enhance carbon sequestration by restoring wetlands. In Prince Edward Island, winter cover crop funding programs reduce nutrient loss in the soil, promote carbon sequestration and reduces direct and indirect losses of nitrous oxide. The Manitoba Government is sharing the cost of on-farm projects to reduce soil nitrous oxide, reduce enteric methane and increase soil carbon sequestration, including such practices as cover cropping, intercropping, and improved grazing. Manitoba has also established the $204 million Growing Outcomes in Watersheds and Conservation Trusts, which will help producers with projects such as restoring wetlands, planting trees, and improving water retention on farmland to improve climate change resiliency.

As of December 2019, six approved Low Carbon Economy Fund projects target the agriculture sector and provide incentives that improve the efficiency of equipment or promote best practices to reduce emissions, and to enhance soil carbon sequestration within the agriculture sector.

4.5.9 Land Use, Land-Use Change and Forestry (LULUCF) Sector

Under the Pan-Canadian Framework, the Government of Canada has committed to reducing emissions and increasing removals through actions in three key areas: increasing stored carbon and advancing innovative practices; increasing the use of wood for construction; and generating bioenergy and advanced bioproducts. Through the Low Carbon Economy Fund, five projects have been implemented which aim at enhancing forest sinks, including by promoting forest regeneration in disturbed areas that have not recovered from harvest or wildfires, and afforestation of idle land.

Launched in 2017, the Forest Bioeconomy Framework for Canada positions Canada to become a global leader in the use of forest biomass for advanced bio-products and innovative solutions. The Framework presents an integrated approach to meeting climate change mitigation commitments and advancing innovation in the forest sector for the long term. It affirms federal, provincial and territorial government commitments to work in partnership with forest communities and industry stakeholders, including continually engaging Indigenous Peoples.

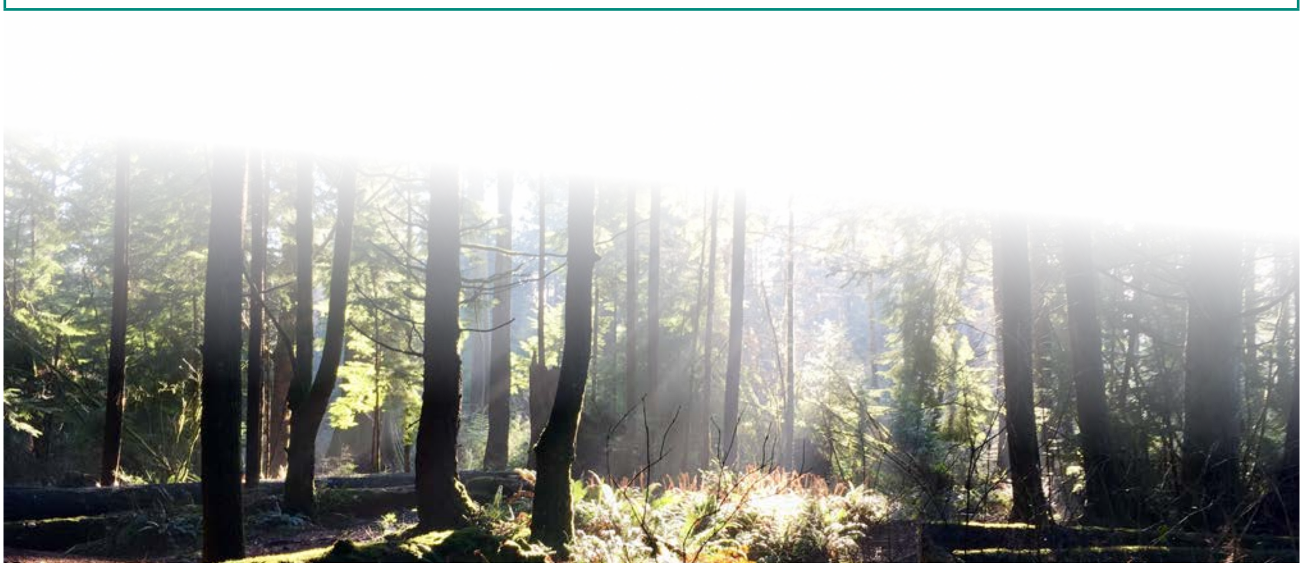
Provinces and territories are also taking action in the LULUCF sector which will contribute to reaching the 2030 target. In British Columbia, the Forest Carbon Initiative (launched in 2017 with support from the federal Low Carbon Economy Fund) includes measures to reduce slash burning, restore forests, and use harvest residues. Other provinces and territories are also looking to address forest pest infestations, increase the use of wood, and invest in the "bioeconomy".

SHORT-LIVED CLIMATE POLLUTANTS

The Pan-Canadian Framework also recognizes that to limit global average temperature rise to well below 2°C above pre-industrial levels and to pursue efforts to limit the increase to 1.5 °C, as called for by the Paris Agreement, reductions in both long-lived GHGs as well as short-lived climate pollutants will be required. Short-lived climate pollutants are a group of GHGs and air pollutants that have a near-term warming impact on climate and can affect air quality. They include black carbon, methane, ground-level ozone, and hydrofluorocarbons. To complement the Pan-Canadian Framework, Canada published a Strategy on Short-Lived Climate Pollutants in July 2017 as part of a holistic approach for meeting climate and air quality objectives.

MID-CENTURY STRATEGY

Complementing the Pan-Canadian Framework, Canada's Mid-Century Long-Term Low-Greenhouse Gas Development Strategy, submitted to the UNFCCC in 2016, describes possible pathways towards long-term decarbonization. The report is based on modelling of different future scenarios, which includes examining emissions-abatement pathways that are consistent with net emissions falling by at least 80% below 2005 levels in 2050. While Canada's mid-century strategy is not a blueprint for action nor is it policy prescriptive, it is meant to inform the conversation regarding how Canada can continue the transition to a low-carbon economy over the longer term. The strategy complements the Pan-Canadian Framework and was developed concurrently.



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4.6 Economic and social implications of measures taken to address climate change

Taking action on climate change will not only reduce GHG emissions, but will also help to reduce the risks that climate change poses to Canadians. Taking action on climate change will help:

- improve health outcomes (for example: reducing air pollution, heat-related illness and climate driven infectious diseases such as Lyme disease);
- cut costs for Canadians (for example: by improving energy and fuel efficiency, and therefore reducing utility bills and the cost of refuelling vehicles; reducing damage associated with climate change and related extreme weather events);
- reduce congestion (for example: by improving public transit networks) and;
- help businesses use cleaner and more efficient technologies (for example: by supporting the adoption of energy management systems).

Canada's climate policies also consider key socio-economic aspects and potential impacts through their implementation.

For example, pursuing clean growth and taking action on climate change generates jobs in new and emerging sectors and helps realize efficiency savings. More importantly, early action to reduce emissions will help avoid the high costs associated with the worst climate impacts. At the same time, Canada recognizes the importance of supporting communities across the country that may be affected by the transition to a low-carbon economy, and taking action on the impacts of climate change that are already being experienced. Canada is taking steps to minimize any adverse impacts for Canadian industries, communities and all sectors of the economy.

This includes for the Pan-Canadian Approach to Pricing Carbon Pollution. It was designed to give provinces and territories the flexibility to implement their own carbon pollution pricing systems for their circumstances, provided they meet the federal stringency requirements. It takes into account the unique circumstances of Canada's northern territories, including high costs of living and of energy, challenges with food security, and emerging economies. For example, under the federal carbon pollution pricing system, relief is provided for aviation fuels, as well as for light fuel (e.g., diesel) and marketable natural gas used by remote power plant operators that generate electricity for remote communities.

In addition, the federal carbon pollution pricing system has been designed specifically to reduce competitiveness impacts on industrial sectors. The federal Output-Based Pricing System for large industrial emitters does this by imposing a compliance obligation on only a portion of emissions from industries that are emissions-intensive and trade-exposed. It sets a performance standard for each sector under the system. Facilities that are less efficient than the standard have to pay. Those that perform better than the standard earn credits that they can sell, or save for future use. It creates a financial incentive for the least efficient facilities to reduce emissions per unit of output and for strong performers to continue to improve.

4.7 Estimates of emission reductions and removals and the use of units from market based mechanisms and LULUCF

Canada's approaches to the use of internationally-transferred mitigation outcomes (market-based mechanisms) and accounting for LULUCF emissions are described in Chapter 3. A more detailed description of Canada's approach to estimating, reporting, accounting, and projection emissions and removals in the LULUCF sector is provided in Annex 2.6.

5.0 PROJECTIONS AND THE TOTAL EFFECT OF POLICIES AND MEASURES

This chapter provides projections of greenhouse gas (GHG) emissions through 2030, aligned to Canada's historical emissions from 1990 to 2017 as presented in Canada's 2019 National Inventory Report (NIR) and Chapter 3 of this report. This chapter presents detailed projections according to Canada's economic sector categories and by gas, aligned with the presentation of policies and measures in Chapter 4. A short presentation of projected emissions by Intergovernmental Panel on Climate Change (IPCC) sector categories is also provided. A description of the relationship between Canada's economic sectors and IPCC sectors can be found in Chapter 3. Canada's GHG inventory is available both online on the Government of Canada website,[4] as well as on the Government of Canada Open Data Portal website.[5]

As described in Chapter 3 of this report, under the Paris Agreement, Canada has committed to achieving an economy-wide target to reduce GHG emissions by 30% below 2005 levels by 2030. Under the Copenhagen Accord Canada committed to reducing GHG emissions by 17% below 2005 levels by 2020. As Canada's plan to meet its international commitments, the Government of Canada worked in close collaboration with provinces and territories and with input from Indigenous Peoples, businesses, nongovernmental organizations, and Canadians from across the country to develop the Pan-Canadian Framework on Clean Growth and Climate Change (Pan-Canadian Framework). As described in further detail in Chapter 4, the Pan-Canadian Framework is a federal, provincial and territorial plan to take ambitious action to reduce emissions and fight climate change, build resilience to a changing climate, and drive clean economic growth.

Projections presented in this report represent both a "with measures" (WM) scenario and a "with additional measures" (WAM) scenario.[6]

- The WM scenario, outlined in Section 5.1, builds on the WM projections presented in Canada's 3rd BR, and also now includes actions taken by governments, consumers and businesses over the last two years, up to September 2019. This scenario does not account for all measures of the Pan-Canadian Framework as a number of them are still under development.
- The WAM scenario, described in Section 5.2, accounts for those additional policies and measures that are under development but have not yet been fully implemented, some of which were announced as part of the Pan-Canadian Framework (e.g., Clean Fuel Standard). This scenario is provided for the purposes of presenting progress to Canada's 2030 target and to better demonstrate the expected impact of the Pan-Canadian Framework.

Under the WAM scenario, emissions in 2030 would decline to 588 Mt (including LULUCF contribution), which is 227 Mt below the WM projections in Canada's Second Biennial Report (BR2) by 2030, or 19% below 2005 levels. This decline, equivalent to approximately a third of Canada's emissions in 2005, is widespread across all economic sectors, reflecting the breadth and the depth of the Pan-Canadian Framework. Figure 5.1 illustrates the contribution of each sector to projected emissions reductions in 2030.

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4 https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/inventory.html

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

6 The policies and measures modeled in each of these scenarios are listed in 7 in Annex 2.1 of this chapter, and several are described in more detail in Chapter 4: Policies and Measures. It should be noted that the sum of emission reductions associated with individual policies and measures—as summarized in Annex1: Policies and Measures of the Biennial Report—will not be equivalent to the overall projected emission reductions of policies and measures in this chapter due to the interaction effects between measures and different modeling approaches.

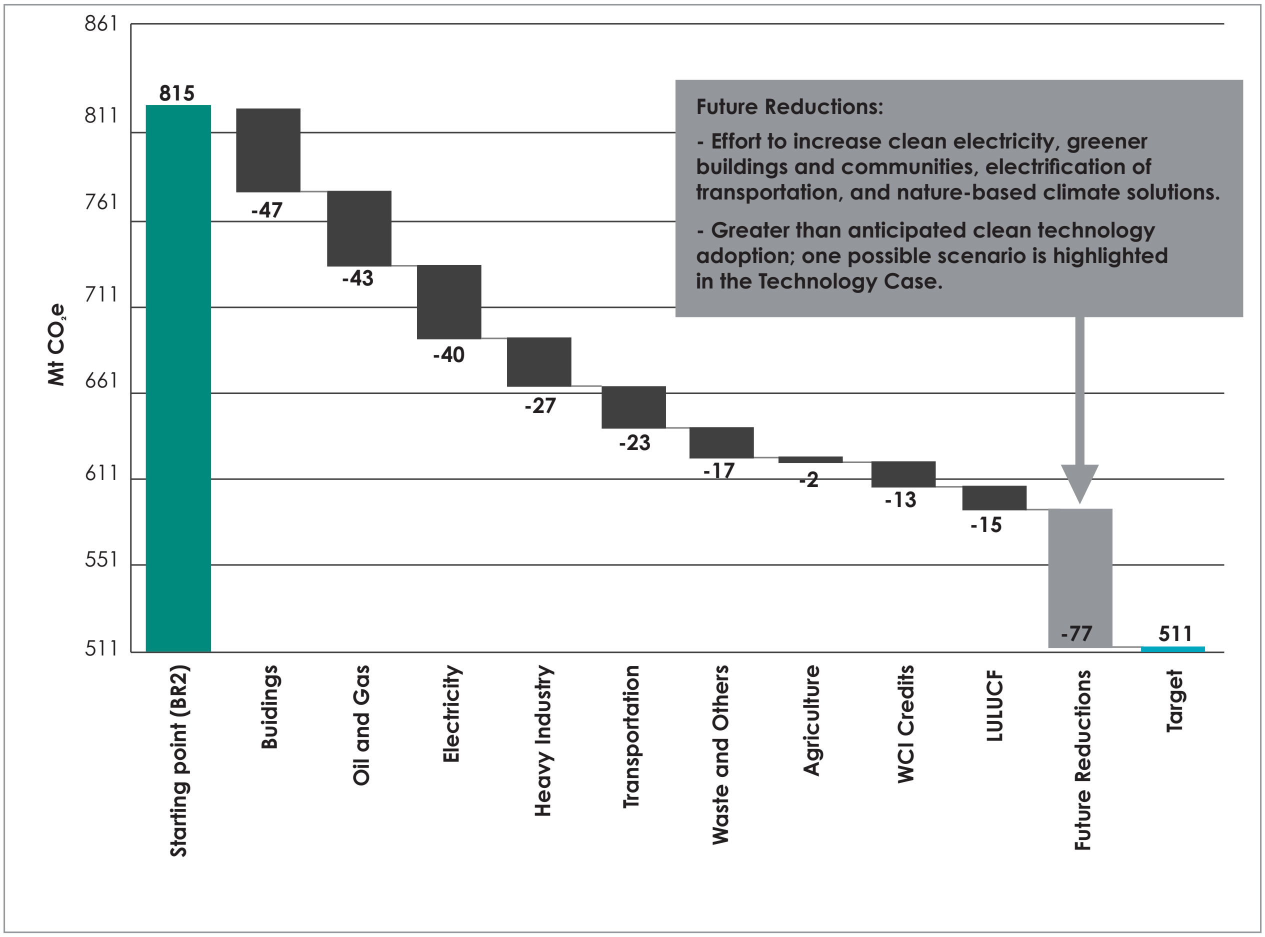

Figure 5.1: Contribution to Emissions Reductions in 2030 (Mt CO_2e)

* In December 2019, Canada's federal government committed to setting a target to achieve net-zero GHG emissions by 2050. As measures toward this target are announced and implemented, they will be included in the modelling and will have an impact on future projected emissions levels. In addition, impacts from the Technology Case (see section 5.2.3) show GHG reductions of 13 Mt in 2030 compared to the WAM scenario. If they materialize, these reductions would reduce the required reductions from unmodelled measures and other future reductions.

Figure 5.2 shows projections under the WM and WAM scenarios, as well as the projections presented in Canada's BR2. Going forward, it is expected that further progress will take place, especially as current estimates do not include the full reductions from investment in clean technology and innovation. In addition, in December 2019, Canada's federal government announced a commitment to set a target of net-zero GHG emissions by 2050, as well as priorities including support for clean electricity generation, greener buildings and communities, the electrification of transportation, and nature-based climate solutions (including a commitment to plant 2 billion trees over the next 10 years). At the time of completing the projections for this report, these commitments had not been formally announced. However, as new measures are announced in more detail and implemented, they will be included in the modelling and will have an impact on future projected emissions levels.

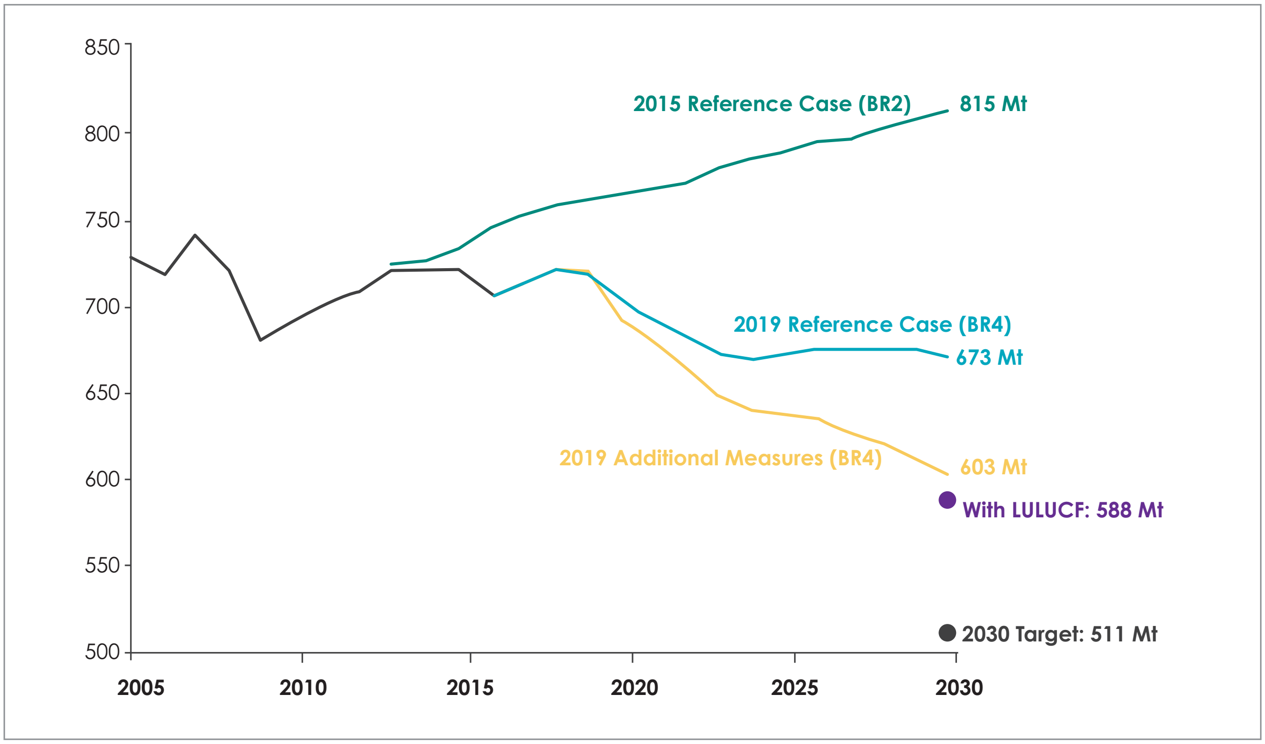

Figure 5.2: Scenarios of Canadian Emissions to 2030 (Mt CO_2 eq)

Moreover, these projected emission reductions do not account for additional mitigation measures that could be implemented by the provinces and territories between now and 2030. Emissions reductions from additional future actions will be assessed as new measures are implemented.

5.1 Greenhouse Gas Emissions Projections by Economic Sector and Gas under the With Measures Scenario

5.1.1 National Emissions Projections

Canada's GHG emissions projections are updated annually, reflecting the latest historical data and up-to-date future economic and energy market assumptions. As such, projections fluctuate over time as a result of changes in these assumptions.

Canada's GHG projections are derived using a detailed bottom-up simulation model where energy data is allocated to individual subsectors using the North American Industrial Classification System. These subsectors are then aggregated into the economic sectors presented in this report. Considering that gross domestic product (GDP) and relative energy prices are key drivers of GHG emissions in most sectors, macroeconomic models are the primary tool for generating emissions projections in Canada. This method of energy and emissions allocation is essential for identifying possible impacts from current and future policies and measures implemented in a particular sector. As for past Biennial Reports, projections were developed using the Energy, Emissions and Economy Model for Canada (E3MC), which is internationally recognized and incorporates external data from consistent sources (for more information on E3MC, please see Annex 2.1).

This section presents Canada's WM Scenario emissions projections to 2030 with comparisons made to 2005, Canada's base year for its GHG emissions reduction target.[7] Projections in the WM Scenario are based on policies and measures in place as of September 2019 and assume no further government action. Two other scenarios are presented in the report. The WAM scenario includes measures that have been announced but are not yet in place (see Section 5.2.1 for more details). The Technology Case (see Section 5.2.3 for more details) is an additional scenario that provides an indication of the sensitivity of projections to faster evolution of technological progress than that assumed in the WM and WAM scenarios.

The list of federal, provincial and territorial policies and measures that were included in the WM scenario is provided in Table A2.39 in Annex 2.3. Where applicable, historical emissions for 2010 and 2017 (the most recent year for which historical emissions are available) are also shown.

5.1.2 Comparing Activity Sector Categories to Economic Sectors

In line with UNFCCC reporting guidelines, Canada has chosen to use economic sectors to present policies and measures as well as projections in our National Communications and Biennial Reports. Examining the historical path of Canadian GHG emissions by economic sector allows for a better understanding of the connection between economic activities and emissions for the purposes of analyzing trends and for policy analysis. This approach is also more closely aligned with that taken in the Pan-Canadian Framework on Clean Growth and Climate Change. It is also presented in Canada's NIR along with GHG emissions categorised under the IPCC reporting requirements by activity sectors. For more information about how Canada reallocates GHG emissions from activity sector categories to economic sectors, please see Annex 2.1.

Table 5.1 illustrates how the projected trends in GHG emissions vary by economic sector, while Table 5.2 provides a breakdown of projected trends in GHG emissions by IPCC sector.

Table 5.1: GHG emissions by Economic Sector (Mt CO_2 eq) under WM Scenario, from 2005 to 2030 (Excluding Land Use, Land-Use Change and Forestry)

	Historical				Projected	
	2005	2010	2015	2017	2020	2030
Oil and Gas	158	159	192	195	206	213
Electricity	119	97	81	74	52	24
Transportation	162	170	174	174	170	153
Heavy Industry	87	74	77	73	77	84
Buildings	86	82	86	85	84	77
Agriculture	72	68	71	72	74	76
Waste & Others	47	43	42	42	43	45
Total	**730**	**693**	**722**	**716**	**705**	**673**

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

At the sectoral level, the expected reductions between 2017 and 2030 come mostly from reductions of 50 Mt and 21 Mt in electricity- and transportation-related emissions. Buildings emissions are also expected to decline by 8 Mt during the period. During the same period, emissions in the oil and gas and heavy industry sectors are expected to experience the highest growth (increases of 18 Mt and 11 Mt, respectively). The agriculture and waste and others sectors are expected to grow modestly during the period (by 3 Mt each). More details about these trends can be found in Annex 2.1.

7 In May 2015, Canada submitted its Intended Nationally Determined Contribution to the UNFCCC. The submission included an economy-wide target to reduce GHG emissions by 30% below 2005 levels by 2030. This submission was updated in 2017 following the release of the Pan-Canadian Framework on Clean Growth and Climate Change. As outlined in the Paris Agreement and accompanying decisions adopted in December 2015, Parties to the UNFCCC were invited to submit final targets as part of ratifying the new agreement and will be obligated to submit revised nationally determined contributions every five years.

Table 5.2: GHG emissions by IPCC Sector (Mt CO_2 eq) under WM Scenario from 2005 to 2030 (Excluding Land Use, Land-Use Change and Forestry)

	Historical				Projected	
	2005	2010	2015	2017	2020	2030
Stationary Combustion and Fugitive Sources	403	372	390	382	370	344
Transport	192	197	202	201	199	186
Industrial Processes	56	51	53	54	57	60
Agriculture	60	55	58	60	62	63
Waste	20	18	19	19	19	19
Total	**730**	**693**	**722**	**716**	**705**	**673**

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

More detailed projections by economic sector and a more detailed comparison between projections by sector categories and economic sectors are provided in Annex 2.1.

5.1.3 Comparison of Current and Previous With Measures Emissions Projections

In 2030, Canada's GHG emissions under the WM Scenario are projected to decline to 673 Mt, or 49 Mt below the WM scenario of 722 Mt presented in Canada's Seventh National Communication and Third Biennial Report (NC7/BR3). This change is primarily driven by new policies and measures that have been put in place since 2017 (such as the Energy Innovation Program and British Columbia's CleanBC plan) and to the addition to the WM scenario of a number of policies and measures previously included in the WAM scenario (such as carbon pollution pricing, amendments to the *Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations* (2012), the Energy Management Program, and actions taken by provinces and territories under the Low Carbon Economy Fund).

Not only have projected emissions changed, but historical emissions have also changed, with revisions going back to 2005, due to improvements and refinements to data sources and methodologies. The change to 2005 GHG emissions resulted in a recalculation of Canada's 2030 target from 517 Mt in NC7/BR3 to 511 Mt, based on the most recent 2019 NIR. Additional information about methodological changes can be found in Annex 2.4.

Table 5.3 (below) presents changes at the economic sector level between the WM scenarios in the Third Biennial Report (BR3) and the Fourth Biennial Report (BR4).

Table 5.3: Comparison of Current WM Scenario Projections with that Presented in BR3, by Economic Sector (Mt CO_2 eq)

	2005		2020		2030		Change	
	BR3	BR4	BR3	BR4	BR3	BR4	2020	2030
Oil and Gas	158	158	197	206	215	213	9	-2
Electricity	117	119	71	52	46	24	-19	-22
Transportation	163	162	168	170	155	153	2	-2
Heavy Industry	86	87	83	77	97	84	-6	-13
Buildings	85	86	88	84	83	77	-4	-6
Agriculture	74	72	71	74	72	76	3	4
Waste & Others	54	47	50	43	53	45	-7	-8
Total	**738**	**730**	**728**	**705**	**722**	**673**	**-23**	**-49**

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

5.1.4 Emissions Intensity

Canadian per capita GHG emissions have been decreasing significantly since 2005 when they were 22.7 tonnes CO_2 eq per person. In 2017, emissions per capita were 19.6 tonnes CO_2 eq per person, the lowest level recorded since records began in 1990.

Projections show per capita emissions should continue to decrease, falling to 16.0 tonnes per person in 2030. This reflects a projected increase in Canada's population of 15% between 2017 and 2030, while emissions in the WM scenario are projected to be 6% lower in 2030 than in 2017.

Figure 5.3 shows the evolution of Canada's GHG emissions intensity per unit of GDP and per capita from 1990 to 2030.

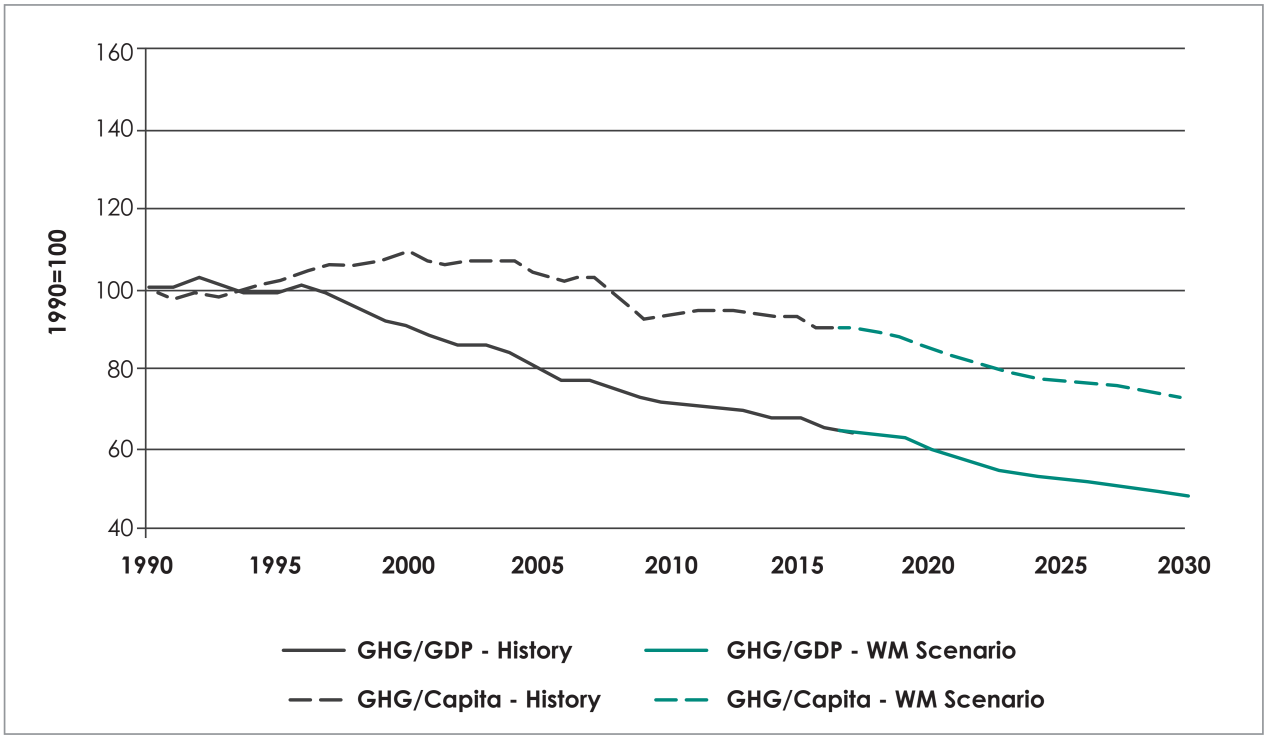

Figure 5.3: Canadian Emissions Intensity per Unit of GDP and per Capita under WM Scenario, 1990 to 2030 (1990 = 100)

5.1.5 Emissions by Gas

Detailed emissions projections by gas and economic sectors are provided in Annex 2.1. Total Canadian GHG emissions over the projection period by gas are presented in natural units in Table 5.4 below. Table 5.5 converts the information into CO_2 eq with global warming potential values from the fourth Assessment Report of the IPCC and provides emissions totals excluding LULUCF emissions.

Table 5.4: Total Canadian Emissions Projections under WM Scenario by Gas, Excluding LULUCF Emissions (kilotonne (Kt)—natural form) from 2005 to 2030

Gas	Historical				Projected	
	2005	2010	2015	2017	2020	2030
CO_2	577 000	556 000	577 000	571 000	571 000	560 000
CH_4	4 200	3 700	3 900	3 700	3 700	3 700
N_2O	120	110	120	130	130	130
HFC	4	5	8	9	9	10
PFC	<1	<1	<1	<1	<1	<1
SF_6	<1	<1	<1	<1	<1	<1
NF_3	<1	<1	<1	<1	n.a.	n.a.

Note: Historical emissions data comes from NIR 2019.

Table 5.5: Total Canadian Emissions Projections under WM scenario by Gas in CO_2 eq, Excluding LULUCF Emissions (Mt CO_2 eq) from 2005 to 2030

Gas	Historical				Projected		Change 2005 to 2030
	2005	2010	2015	2017	2020	2030	
CO_2	577	556	577	571	560	542	-35
CH_4	106	93	96	93	92	80	-26
N_2O	37	33	37	38	39	40	3
HFC	5	8	11	13	14	10	5
PFC	4	2	1	1	1	<1	-3
SF_6	1	<1	<1	<1	<1	<1	-1
NF_3	<1	<1	<1	<1	n.a.	n.a.	0
Total	**730**	**693**	**722**	**716**	**705**	**673**	**-57**

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

5.1.6 LULUCF Sector

The LULUCF projection estimates presented in Table 5.6 are modeled separately from the other sectors. The table provides projected aggregated estimates for the LULUCF sector; the detailed breakdown by LULUCF sub-sectors of projected emissions with the description of the methodologies are provided in Annex 2.6.

Table 5.6: LULUCF sector net GHG flux estimates for selected years

	Net GHG flux (Mt CO_2 eq)									
	Historical Estimates								Projected Estimates*	
	1990	2005	2012	2013	2014	2015	2016	2017	2020	2030
Total LULUCF	-68	-21	-36	-33	-32	-25	-25	-24	-22	-10

* Historical estimates include all LULUCF sub-categories. Projected estimates include only sub-sectors for which projections are available, i.e. they exclude grassland, settlements remaining settlements and other land sub-sectors.

The accounting contribution for Canada's forest sector and harvested wood products is calculated using the Reference Level approach. For the rest of the LULUCF sub-sectors the accounting contribution is calculated using the net-net approach, using 2005 as the base year. Details of these calculations by LULUCF sub-sector are provided in Annex 2.6. Aggregated accounting contribution for LULUCF sectors is presented in Table 5.7.

Forest Land remaining Forest Land (FLFL) and associated harvested wood products (HWP) provide the largest share of the overall accounting result and show a growing accounting contribution (see Annex 2.6) through to 2017 because actual harvest rates continued to remain below the historical average harvest levels used to calculate the Reference Level. After 2020, the projected harvest rates and Reference Level harvest rates increasingly converge, reducing the accounting contribution from FLFL and associated HWP.

Table 5.7: LULUCF Accounting Contribution

	(Mt CO_2 eq)							
	Historical Estimates						Projected Estimates*	
	2012	2013	2014	2015	2016	2017	2020	2030
Total LULUCF Accounting Contribution	-0.15	-5.3	-9.4	-13	-15	-17	-23	-15

* Historical estimates include all LULUCF sub-categories. Projected estimates include only sub-sectors for which projections are available, i.e. they exclude grassland, settlements remaining settlements and other land sub-sectors.

5.1.7 Emissions by Province

Emissions vary considerably by province, driven by diversity in population size, economic activities, and resource base, among other factors. For example, provinces where the economy is oriented more toward resource extraction tend to have higher emissions levels whereas more manufacturing or service-based economies tend to have lower emissions levels. Electricity generation sources also vary, with provinces that rely on fossil fuels for their electricity generation having higher emissions than provinces that rely more on non-emitting sources of electricity, e.g. hydroelectricity, nuclear, wind and solar.

Table 5.8 displays projected provincial and territorial GHG emissions from 2005 to 2030. The projected emissions reflect a diversity of economic factors and government measures to reduce GHG emissions. These include energy efficiency and renewable electricity programs, carbon pricing, regulatory measures, and legislated renewable electricity targets.[8]

8 Although provincial and territorial governments have announced a diverse range of measures, only measures that could be readily modeled or have an announced regulatory or budgetary dimension were modeled. Aspirational goals and targets that were not supported by measurable, real and verifiable actions were not included in the projections. The policies and measures modeled in this section are listed in Table A2.38 in Annex 2 of this report.

Table 5.8: Provincial and Territorial GHG Emissions (Mt CO_2 eq) under WM Scenario, from 2005 to 2030 (Excluding LULUCF)

	Historical				Projected		Change 2005 to 2030
	2005	2010	2015	2017	2020	2030	
Newfoundland and Labrador	10	10	11	11	11	9	-1
Prince Edward Island	2	2	2	2	2	2	< -1
Nova Scotia	23	20	17	16	15	11	-13
New Brunswick	20	18	14	14	14	10	-10
Québec	86	80	78	78	77	73	-14
Ontario	204	174	165	159	161	160	-44
Manitoba	20	19	21	22	22	22	2
Saskatchewan	68	69	79	78	75	68	< -1
Alberta	231	239	275	273	265	258	27
British Columbia	63	59	59	62	61	59	-4
Yukon Territory	1	1	<1	1	1	1	< 1
Northwest Territory	2	1	2	1	2	1	< -1
Nunavut	<1	<1	1	1	1	1	1
Canada	730	693	722	716	705	673	-57

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

5.2 Assessment of Aggregate Effect of Policies and Measures

5.2.1 With Measures and With Additional Measures Scenarios

Since the submission of Canada's BR2 a number of policies and measures have been implemented, which have resulted in significantly lower emissions projections under the WM scenario, decreasing to 673 Mt in 2030 (not including LULUCF), or 8% below 2005 levels.

A number of policies included in the WAM scenario in Canada's Seventh National Communication and Third Biennial Report, such as carbon pollution pricing, accelerated coal phase-out, the Low Carbon Economy Fund, and a number of other programs, have been legislated and/or gotten the funding, are now also included in Canada's WM scenario.

Nevertheless, there remain policies and measures that have been announced under the Pan-Canadian Framework, but have not yet been fully implemented. This includes the following policies and measures:

- The Clean Fuel Standard, which will reduce the lifecycle emissions intensity of most liquid, gaseous and solid fuels used in Canadian transportation, industry, homes and buildings. The objective of the Clean Fuel Standard is to achieve 30 Mt of annual reductions in GHG emissions by 2030;
- retrofit building codes for existing buildings, net-zero ready building codes for new buildings, as well as more stringent standards for equipment and appliances in the buildings sector;
- measures in the transportation sector targeting off-road vehicles and further extension of the light duty vehicle standards for the vehicles of the post-2025 model years;
- improving electricity transmission system by building strategic interconnections;
- and other policies (please refer to Table A2.39 for a full list of measures included in the WAM scenario).

As discussed in Chapter 3, Canada will continue to work with interested provinces and territories, as well as with international partners, to ensure that allowances acquired through international-emissions trading are counted towards Canada's international targets. This includes purchases of credits under the Western Climate Initiative (WCI).

According to the WAM scenario, which accounts for all of these measures, as well as 13 Mt of projected purchases of credits under the WCI, Canada's projected emissions in 2030 are expected to decrease to 603 Mt, excluding LULUCF.

Another area of significant reporting and quantification progress since Canada's NC7/BR3 is the LULUCF sector and determination of its accounting contribution towards Canada's climate change targets. The LULUCF sector is projected to reduce Canada's emissions by 15 Mt in 2030. Full quantification details for the LULUCF contribution both for the historical and projected periods are provided in Annex 2.6.

Canada's emissions including LULUCF in 2030 under the WAM scenario are projected to decline even further to 588 Mt, which is 227 Mt below the WM projections in Canada's BR2, or 19% below 2005 levels.

It is expected that GHG estimates will continue to decline in the medium term, especially as current estimates do not include the full reductions from investment in green infrastructure, clean technology and innovation. In addition, as mentioned above, a new federal commitment to target net-zero emissions by 2050, and associated mitigation priorities (clean electricity, greener buildings and communities, electrification of transportation, and nature-based climate solutions), were not formally announced at the time of completing the projections for this report. As they are announced in more detail and implemented, they will be included in the modelling and will have an impact on future projected emissions levels.

Table 5.9: GHG Emissions by Economic Sector in WM and WAM scenarios, 2005 to 2030 (Mt CO_2 eq)

	Historical				Projected			
					With Measures		With Additional Measures	
	2005	2010	2015	2017	2020	2030	2020	2030
Oil and Gas	158	159	192	195	206	213	206	199
Electricity	119	97	81	74	52	24	51	18
Transportation	162	170	174	174	170	153	170	141
Heavy Industry	87	74	77	73	77	84	77	80
Buildings	86	82	86	85	84	77	80	62
Agriculture	72	68	71	72	74	76	74	74
Waste & Others	47	43	42	42	43	45	43	42
WCI Credits	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-8	-13
LULUCF	n.a.	n.a.	n.a.	n.a.	-23	-15	-23	-15
Total	**730**	**693**	**722**	**716**	**682**	**658**	**670**	**588**

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

Table 5.10: Provincial and Territorial GHG Emissions (Mt CO_2 eq) from 2005 to 2030 Under the WAM scenario (Excluding LULUCF)

	Historical				Projected – Additional Measures	
	2005	2010	2015	2017	2020	2030
Newfoundland and Labrador	10	10	11	11	11	8
Prince Edward Island	2	2	2	2	2	1
Nova Scotia	23	20	17	16	15	8
New Brunswick	20	18	14	14	14	9
Québec*	86	80	78	78	68	53
Ontario	204	174	165	159	159	145
Manitoba	20	19	21	22	22	20
Saskatchewan	68	69	79	78	75	62
Alberta	231	239	275	273	263	238
British Columbia	63	59	59	62	60	56
Yukon Territory	1	1	<1	1	1	<1
Northwest Territory	2	1	2	1	2	1
Nunavut	<1	<1	1	1	1	1
Canada	730	693	722	716	693	603

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

* Projections for Québec include credits from the Western Climate Initiative.

5.2.2 Comparison of Current and Previous With Additional Measures Emissions Projections

Relative to Canada's BR3 WAM projections, changes in the BR4 WAM projections are mostly due to changes in provincial climate policies, most notably Ontario's repeal of its cap-and-trade legislation and revision in provincial target, as well as updated macroeconomic assumptions such as population growth and oil and gas production forecasts. The change in expected reductions from Ontario has been offset to some extent by the inclusion of the expected LULUCF accounting contribution in 2030. New policies, such as CleanBC, the Energy Innovation Program and the federal incentive for zero-emission vehicles also helped shrink the resulting void.

Table 5.11 presents changes in provincial and territorial projected emissions between the WAM scenarios in BR3 and BR4.

Table 5.11: Comparison of Current WAM Scenario Projections with that Presented in BR3, by Economic Sector (Mt CO_2 eq)

	BR3	BR4	Change
Oil and Gas	192	199	8
Electricity	21	18	-3
Transportation	143	141	-2
Heavy Industry	93	80	-13
Buildings	71	62	-9
Agriculture	71	74	3
Waste & Others	51	42	-9
WCI Credits	-59	-13	46
LULUCF	N.A.	-15	-15
Total	**583**	**588**	**5**

5.2.3 Technology Case

The Technology Case (TC) is an additional scenario that was modeled to provide an indication of the sensitivity of energy and emissions projections to faster evolution of technological progress than that assumed in the WM and WAM scenarios. As is the case for the other scenarios, TC is not a prediction of the future, but one possible outcome under certain conditions. The TC should also not be construed as a recommendation of certain policies, technologies or outcomes. All starting assumptions on economic growth, energy prices and oil production are those used in the WM and WAM scenarios. The TC is generally consistent with the assumptions in Canada Energy Regulator TC, which was published in 2018 and in turn is aligned to the global assumptions in the International Energy Agency World Energy Outlook 2018 "Sustainable Development Scenario.[9,10]" Still there are two aspects of the TC that make the scenario presented in this report different: it does not

9 International Energy Agency (2017). World Energy Outlook 2017. France. Available from: https://webstore.iea.org/world-energy-outlook-2017.

10 Canada Energy Regulator (2018). *Canada's Energy Future 2018: Supply and Demand Projections to 2040. Government of Canada. Calgary, Alberta. Available online at* http://www.CER.gc.ca/nrg/ntgrtd/ftr/2018/chptr4-eng.html.

include drops to crude oil and natural gas prices or increasing carbon prices that could occur under stricter global commitments to reduce GHGs; and it includes credits attributable to the output-based allocations for industry under the federal carbon pricing backstop. The TC explores the impact of the uptake of more efficient equipment, fuel switching, changes in industrial processes and reduction in capital costs of renewable electric generation.

There are several emerging technologies and trends incorporated in the TC that have significant potential to reduce energy use and emissions. These technologies and trends include heat pumps, electric vehicles (EVs), steam-assisted gravity drainage (SAGD) solvent extraction, use of inert anodes in aluminum smelting, and reduced capital costs for electric renewable generation.

Geothermal and air source heat pumps are two to five times more efficient than conventional sources of heat for space and water heating thus increased adoption of these technologies could play an important role in decarbonizing Canada's building sector. Electric vehicles are expected to become more cost-competitive than internal combustion engines (ICE) by 2025; declining battery costs, reduced operating and maintenance costs compared to ICE vehicles and increased charging infrastructure could result in rapid EV uptake and a transformation of the transportation sector.

Finally, additional potential exists in the electric generation sector for reducing emissions through greater uptake of non-hydro renewables. For wind and solar power, capital costs are substantial components of the levelized cost of electricity. Given that the choice between building additional renewable or fossil fuel related capacity is highly dependent on relative levelized costs, substantial drops in overnight capital costs[11] for wind and solar could lead to a greener electricity grid.

While impacts from the TC show GHG reductions of 13 Mt in 2030 compared to the WAM scenario, impacts beyond 2030 will be substantially more as equipment turnover results in more fuel efficient and cleaner burning equipment being reflected in capital stocks. Annex 2.1 presents additional details and results on the TC.

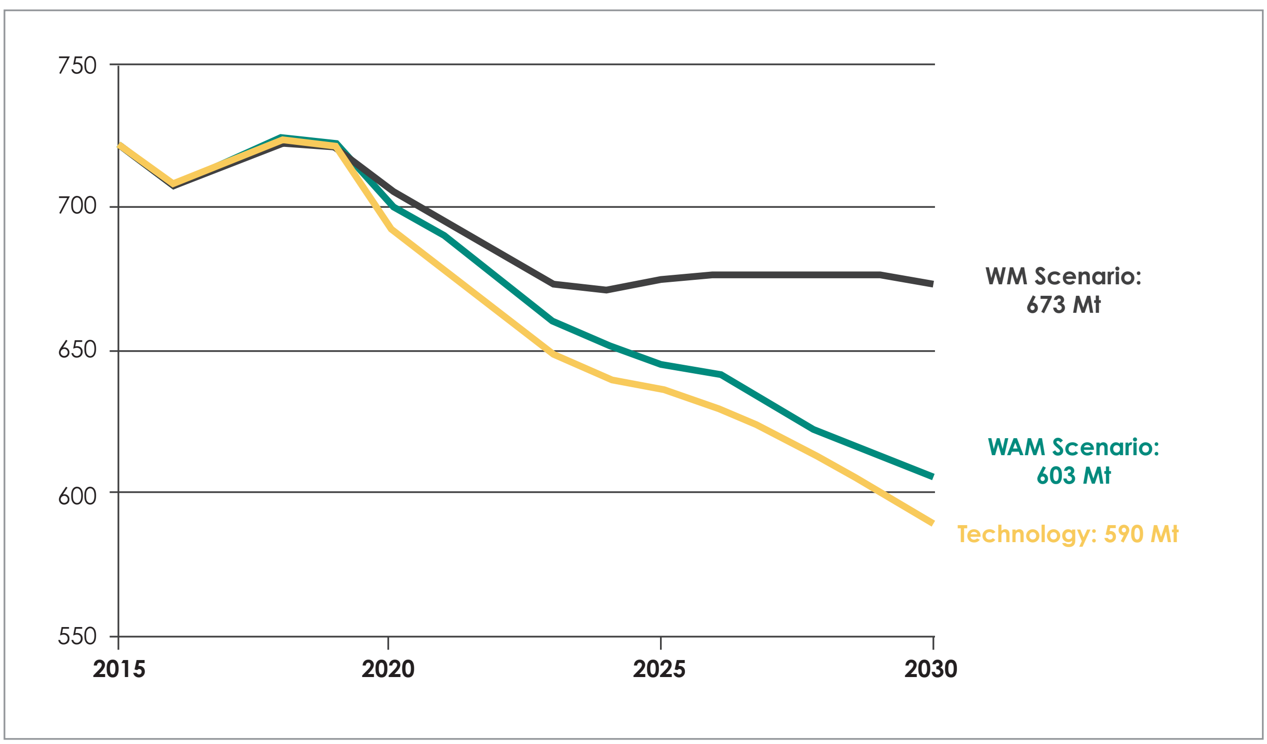

Figure 5.4: Canada's GHG emissions projections under the WM, WAM and TC (excluding LULUCF)

11 Overnight capital cost is a term used to describe the cost of building a power plant 'overnight' and does not take into account financing costs.

5.3 Sensitivity Analysis

Canada develops its scenarios of emissions projections using E3MC, a detailed, proven energy, emissions and economy model. Each year, the model is re-calibrated using the most recent data available (see Annex 2.7) to provide a robust, well-grounded in empirical evidence forecast. Nevertheless, uncertainty is inherent in the projections of any model that looks decades into the future. To address this issue, this section presents alternative scenarios showing the sensitivity of GHG emission projections to projected energy prices and economic growth. That said, other sources of uncertainty exist, and they are discussed in more details in Annex 2.5.

Given the uncertainty regarding the key drivers of GHG emissions, the scenarios presented in the previous section should be seen as one estimate within a set of possible emissions outcomes in the projection period, as events that will shape emissions and energy markets cannot be fully anticipated. In addition, future developments in technologies, demographics and resources cannot be foreseen with certainty. The variation in these complex economic and energy variables implies that modeling results are most appropriately viewed as a range of plausible outcomes. Environment and Climate Change Canada (ECCC) addresses this uncertainty via modeling and analysis of alternative cases. The TC (see Section 5.2.3) is one where evolution of technology and its adoption happens faster than that assumed in the WM and WAM scenarios, which have conservative assumptions about the rate of technology development and deployment. Finally, a set of scenarios has been developed to take into consideration the uncertainty related to future economic growth, oil and natural gas prices and production.

Projections are updated annually and reflect the latest historical data and up-to-date future economic and energy market assumptions. Uncertainty is addressed via modelling and analysis of alternate cases that focus on variability in two key factors: future economic growth and population projections and the evolution of oil and natural gas prices and production. These assumptions are presented in Table 5.12 and Table 5.13, and the overall range of emissions is presented in Figure 5.5.[12]

Table 5.12: Economic Growth and Population from 2019 to 2030

	2019 to 2030		
	Low	With Measures	High
Annual GDP Growth Rate	0.70%	1.72%	2.72%
Annual Population Growth Rate	0.70%	1.01%	1.37%

Table 5.13: Oil and Gas Prices and Production in 2025 and 2030

FUEL	UNITS	2025			2030		
		Low	With Measures	High	Low	With Measures	High
Crude Oil Price (WTI)	2017US$/bbl	34	66	110	35	69	113
Heavy Oil (WCS)	2017US$/bbl	21	54	98	22	57	102
Crude Oil	1000 bbl/day	4008	5217	5794	3704	5688	6530
Natural Gas (Henry Hub)	2017US$/MMBTU	2.05	2.88	3.82	2.23	3.42	4.38
Natural Gas	Billion Cubic Feet	4757	7030	7993	4385	7994	9589

12 The High and Low alternate emissions scenarios from presented in this section are equivalent to the Fast GDP – High World Oil Prices and Slow GDP – Low World Oil Prices scenarios respectively in Annex 2.5.

Table 5.14: Sensitivity of GHG Emissions to Changes in GDP and Prices (excluding LULUCF) in Mt CO_2 eq

Scenarios	2025	2030	2030 Projections - 2005 Emissions
Slow GDP, Low World Oil and Gas Prices	620	583	-147
Fast GDP, High Oil and Gas Prices	709	729	-1
With Measures Scenario	705	673	-57
Sensitivity Range	620 to 709	583 to 729	-147 to -1

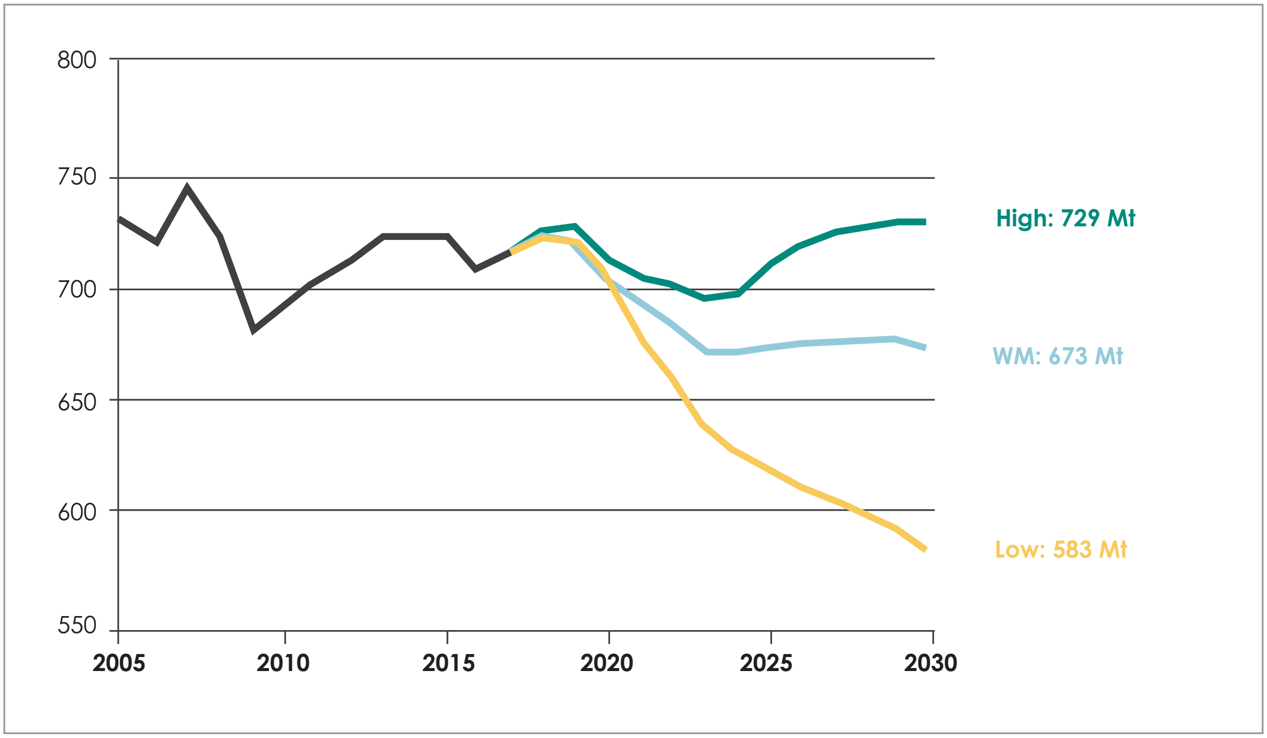

Figure 5.5: Canada's Domestic Emissions Projections (Mt CO_2 eq): Low, WM and High Scenarios

6.0 PROVISION OF FINANCIAL, TECHNOLOGICAL AND CAPACITY-BUILDING SUPPORT TO DEVELOPING COUNTRY PARTIES

6.1 Finance

6.1.1 Introduction

The impacts of climate change are increasingly felt in communities across the world, especially in developing countries who are the most severely hit and the least equipped to respond to its consequences. The poorest and most vulnerable communities are experiencing the effects of climate change through extreme weather events such as hurricanes, sea level rise, and an increased spread of vector-borne diseases. Climate change has the potential to reverse significant development gains made in developing countries. In 2015, recognizing the need for critical support in developing countries to prevent and cope with the devastating consequences arising from climate change, Canada announced a climate finance commitment of $2.65 billion over five years. This support is resulting in enhanced resilience for the poorest and most vulnerable people, reduced greenhouse gas (GHG) emissions, and important amounts of co-financing mobilized for climate action, especially from the private sector, in developing countries.

Under the United Nations Framework Convention on Climate Change (UNFCCC), Canada is determined to continue working hand-in-hand with the international community to implement the Paris Agreement and to scale up climate investments in developing countries. Canada's climate finance supports the objectives of the Paris Agreement, including making finance flows consistent with a pathway towards low GHG emission and climate-resilient development. To this end, Canada continues to explore a variety of factors, such as the use of public finance to facilitate investments from the private sector, by reducing financial and technical barriers that undermine climate investments. In addition, in keeping with Paris Agreement priorities, Canada's $2.65 billion commitment is supporting Small Island Developing States (SIDS) and Least Developed Countries (LDCs) achieve ambitious action on climate change, recognizing the unique climate challenges that they face.

Canada is committed to the climate finance goal under the Paris Agreement to jointly mobilize US$100 billion annually, by 2020, from a wide variety of sources. Since committing to this collective goal, developed countries have been significantly scaling up financial support for developing countries. According to analysis recently undertaken by the Organisation for Economic Co-operation and Development (OECD), climate finance continues to ramp up. In 2017, developed countries delivered US$71.2 billion in climate finance, up from US$52.2 billion in 2013.[13] Canada continues working with partners to pursue innovative approaches to support developing countries in mitigating and adapting to climate change.

6.1.2 Overview of Canada's Climate Finance Over 2017 and 2018

Over 2017 and 2018, Canada provided approximately $1.5 billion to developing countries for climate action (Figure 6.1). This support includes: $704 million as part of Government of Canada's $2.65 billion climate finance commitment; $246 million as part of its regular international assistance projects with a climate

13 OECD (2019), *Climate Finance Provided and Mobilised by Developed Countries in 2013-17*, OECD Publishing, Paris, https://doi.org/10.1787/39faf4a7-en.

change component[14]; $17 million from Canadian provincial and municipal support; $509 million from its export credit agency, Export Development Canada (EDC), to mobilize private finance; and US$30 million by the newly established development finance institution, FinDev Canada, for climate-related investments. Detailed project-level information is available in Common Tabular Format Tables 7a and 7b.

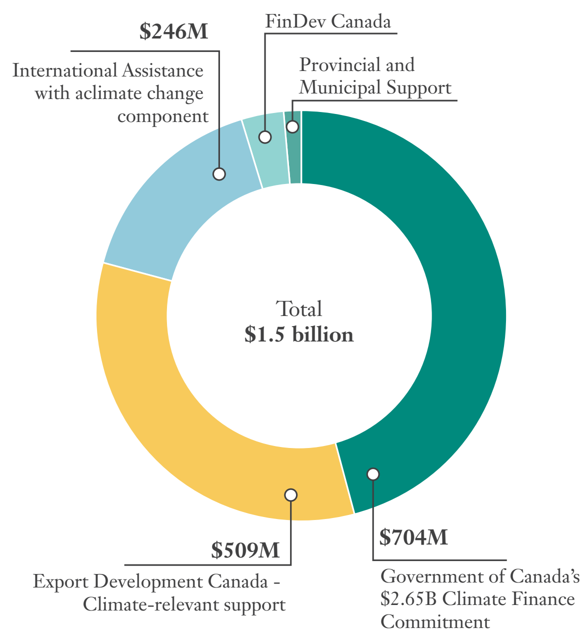

Figure 6.1: Canada's public climate finance delivered over 2017 and 2018

Key focus areas and type of support

Canada supports a wide range of initiatives in key sectors, such as renewable energy, smart-agriculture, and disaster prevention and preparedness. Of Canada's climate finance provided over 2017 and 2018, $192 million targeted climate change adaptation, delivering on Canada's commitment of increasing adaptation support. $315 million was provided for mitigation initiatives and $498 million for cross-cutting initiatives (both adaptation and mitigation efforts).[15] In addition, support provided over 2017 and 2018 covered a wide geographical area, with 54 countries directly benefiting from Canada's climate finance and various other countries benefitting from Canada's support through multilateral funds.

Canada continues to build and strengthen the tools and partnerships essential for delivering impactful climate finance.

Canada's climate finance supports the institutions and financial mechanism of the UNFCCC, recognizing the fundamental role that they play in global action on climate change, in support of the Paris Agreement. Canada continues to support the Green Climate Fund, the world's largest dedicated climate change fund, with its initial $300 million contribution announced in 2014.[16] Canada has also been a strong supporter of the Global Environment Facility and continues to be so through its regular contributions, which allow pursuing valuable activities to address climate change in developing countries. In addition, Canada supports the Least Developed Countries Fund through its $30 million contribution to address the urgent adaptation needs of the poorest and most vulnerable countries. Besides, through its core contributions to multilateral development banks (MDBs), Canada's support allows for ambitious climate action in developing countries through trusted channels and mechanisms.

Canada's climate finance also helps to empower women and girls through climate action, working with the private sector and non-traditional donors to multiply climate investments, and continuing to take action on the cross-cutting implications of climate change in regards to development.

Women and girls continue being disproportionately impacted by the adverse effects of climate change due to a range of economic and social factors. At the same time, women and girls still do not fully take part in deciding climate action, despite their crucial role in leading the fight against climate change in their communities. Canada's climate finance has a strong focus on the empowerment of women and girls and gender equality, in line with Canada's Feminist

14 Projects outside of the $2.65 billion commitment, as part of Government of Canada's efforts to integrate climate change considerations into development funding

15 Includes all components from Figure 6.1, except support from Export Development Canada

16 On August 26th 2019, the Government announced a new contribution of $300 million, over four years, to the Green Climate Fund's first replenishment process.

International Assistance Policy. Canada works with a wide range of partners, including international organizations, government institutions, businesses and civil society, to advance gender mainstreaming and ensure that women and girls play a leadership role in designing, developing and implementing climate change adaptation and mitigation strategies.

The impacts of climate change also have undeniable repercussions on people's lives and livelihoods in all other areas of development such as food security, health and safety, security, and economic growth. In order to accelerate progress by taking into account the evident interlinkages between climate and development, Canada continues to integrate climate considerations into its development funding. Canada's climate finance further contributes to the Sustainable Development Goals, including Goal 13 – Climate Action.

To attract investment on the scale required, Canada puts emphasis on working with a variety of actors to direct additional investments towards climate action. This includes engaging with partners, in particular the private sector, but also non-traditional donors, such as philanthropists to achieve the level of investment urgently needed for a transition to low-carbon and resilient economies. Canadian provinces, territories and municipalities also support a wide variety of development projects that address climate change and are playing an increasingly important role in sustained climate finance flows.

6.1.3 Addressing the Needs and Priorities of Developing Countries

Canada's climate finance is delivered through a range of financial instruments and channels to address the complex set of needs and priorities of developing countries across sectors and regions. Choosing the right instruments and delivery channels drives transformational and efficient delivery of climate finance by maximizing access to finance, consistent with developing countries' needs. Canada uses grant financing where cost-effective market-based financing is not viable, such as for most adaptation projects in the poorest and most vulnerable countries. Alternatively, non-grant financing, including on concessional terms, is the primary choice when viable market-based financing is constrained by factors such as capital availability, market failures, and perceived risks.

Canada's support is also delivered through various partners and channels to implement the most suitable projects for country recipients. Our multilateral partners include trusted multilateral organizations that have the expertise and reach to deliver strong climate results. For example, through a $200 million investment for the Canadian Climate Fund for the Private Sector in Asia II at the Asian Development Bank, Canada is providing US$30 million in support of a 216 megawatt run-of-the-river hydro power plant in Nepal, which will reduce imports of electricity into the country, contributing to its long-term energy security, sufficiency and sustainability. Our bilateral partners work directly with people and communities in developing countries, building local capacity and offering valuable expertise and understanding of the local context in which they operate. For example, through the International Development Research Centre, Canada supported the African Institute for Mathematical Sciences (AIMS) in building a critical mass of scientists to contribute to climate change solutions in Africa. AIMS is also contributing to the advancement of women through a special emphasis on recruiting and supporting women in math and science. Canada also recognizes that adaptation is a priority for many developing countries and that increased efforts are necessary to support them in building resilience against the increasingly adverse effects of climate change. That is why Canada is increasing its support provided for adaptation action, especially for the poorest and most vulnerable. For example, Canada has announced $100 million in support of the expansion of climate risk insurance coverage in climate-vulnerable countries, to strengthen abilities to building back better and faster following natural disasters such as hurricanes or floods. Canada is demonstrating global leadership on climate change adaptation as a convening country and funding partner (contributing $7.5 million) to the Global Commission on Adaptation, a two-year international initiative to raise the profile of adaptation and mobilize solutions. During the first year of the commission, Canada contributed to the creation of a flagship report and call to action for adaptation (published here: https://gca.org/global-commission-on-adaptation/report). Now, throughout the Commission's second year, (October 2019-October 2020), Canada is taking a leadership role on nature-based solutions, one of the 8 priority areas for adaptation identified by the Commission.

Canada further supports developing countries in the implementation of their Nationally Determined Contributions (NDCs), in which each country outlines their ambitious action on climate change in light of their national circumstances. As part of its $2.65 billion commitment, Canada is providing $19.7 million in support of NDC implementation in the areas of waste management, oil and gas, and strengthening of measurement, reporting and verification activities in countries such as Chile, Mexico, Cote-d'Ivoire, Senegal and Vietnam.

Canada recognizes the barriers and challenges that developing countries face in accessing climate finance support. Canada will continue to take action in this regard, including by supporting international initiatives with the aim of making finance more accessible. For example, Canada is collaborating with the Rocky Mountain Institute to find concrete solutions that will address the bottleneck of climate finance investments. This initiative aims to enhance capacity in LDCs, SIDS and African countries to navigate the climate finance architecture and secure finance for specific projects stemming from countries' investment priorities.

6.1.4 Scaling up Climate Finance

Mobilizing private sector investment for climate action

Increased level of investment will be needed to transition the global economy towards a low-carbon and resilient path. This global shift of financial flows will not be achieved by public finance alone. Addressing climate change requires all actors, public and private, to engage in climate action and shift investments towards the noteworthy climate investment opportunities for the private sector. Analysis from the International Finance Corporation (IFC)[17] revealed that the Paris Agreement helped open up nearly US$23 trillion in opportunities for climate-smart investments in emerging markets by 2030.

Canada is working collaboratively with a number of multilateral organizations to provide innovative financing aimed at removing investment risks to the private sector. Specifically, Canadian facilities were established at MDBs designed to catalyze private sector investments, namely at the Asian Development Bank, the Inter-American Development Bank and the World Bank.[18] Through these funds, Canada is using targeted amounts of concessional finance to demonstrate the commercial viability of projects and unlock future private investments in similar initiatives. For example, through the IFC-Canada Climate Change Program, to which Canada contributed $351.8million[19], US$39 million were invested to build three biomass power plants in the Philippines that have the potential to become the first commercial-scale power generation plants converting sugarcane waste to electricity in the world. This innovative project approved in 2016 is mobilizing private finance and aims to create a demonstration effect, encouraging the private sector to undertake similar projects, aside from also providing significant development impact by generating electricity from renewable sources.

The OECD's Development Assistance Committee (DAC) has developed an international standard for measuring and attributing the volume of private finance mobilised by official development finance intervention, including for climate action. This work has been conducted in close co-operation with the OECD Research Collaborative for Tracking Finance for Climate Action and continues to mature. Using the OECD-DAC approach, Canada estimates that approximately US$309 million[20] of private finance for climate-related activities was mobilised in developing countries over 2017 and 2018, via its investment of US$213 million in public finance. Given the challenges in tracking private finance mobilised and the relative newness of collecting this data and applying the OECD-DAC methodologies, these figures are estimates.

17 Report "Climate Investment Opportunities in Emerging Markets", 2016

18 See Annex 3.1 for the list of Canadian facilities at MDBs and the project-level breakdown.

19 This is Canada's total contribution to the Program, with a $291.55 million contribution in 2011 and an additional $60.3 million contribution in 2013 to the IFC Catalyst Fund.

20 Available figures for 2018 are still at initial stages as of the preparation of this report.

In addition to what Canada reports as climate finance, Canada continues to provide core support to MDBs that play a key role in scaling up climate funding for developing countries. Canada estimates that it provided $293 million over 2017 and 2018 in core contributions to MDBs that support climate activities in developing countries.[21]

Canada estimates that repayable contributions of approximately $14 million in 2017 and $33 million in 2018 have been returned to Canada from Canadian climate facilities at MDBs. The successful performance of these projects is demonstrating how using public funding can catalyze investment in climate change action in developing economies.

Action by Export Development Canada and FinDev Canada

In scaling up climate finance, Canada's export credit agency and its Development finance institution FinDev Canada both play a key role in financing substantial climate action in developing countries.

Export credit agencies contribute to the global goal to address climate change by spurring investment in climate activities around the world. Export Development Canada (EDC) [22] contributes to the Government of Canada's priority to support a global transition to a low carbon economy in line with the objectives of the Paris Agreement. EDC contributed to global efforts to address climate change by providing $278 million in 2017 and $231 million in 2018 to climate finance activities in developing countries.

In 2018, EDC became the first export credit agency in the world to commit to implementing the recommendations of the Task Force on Climate-related Financial Disclosures, joining Canadian commercial banks, along with a number of Canadian pension funds and large companies, in helping to advance the availability, consistency and comparability of climate-related information.

In January 2019, EDC also released its new Climate Change Policy, another significant step in its contribution to the global transition to a low-carbon, sustainable economy. Commitments in the new policy include: no new financing for coal-fired power plants, thermal coal mines or dedicated thermal coal–related infrastructure – regardless of geographic location and integrating climate-related considerations, such as carbon intensity, into EDC's risk assessment processes.

Development finance institutions also play a key role on the road to the US$100 billion goal as they directly channel development finance to mobilize private investments. FinDev Canada has the mandate to provide financial services to the private sector in developing countries with the aim of combating poverty through economic growth. Financing is focused on three main themes: market development through, among other things, job creation, women's economic empowerment and climate change mitigation and adaptation.

FinDev Canada has committed US$30 million of climate relevant investments in 2018. It approved its first transaction in February 2018 – an investment of US$10 million to expand off-grid renewable solar energy for low-income households in Africa that have historically relied on kerosene and other traditional fuels.

6.1.5 National Approach to Tracking Finance Support

Canada's climate finance is delivered through various federal departments, sub-national governments and agencies, including Global Affairs Canada, Environment and Climate Change Canada and the International Development and Research Centre. These departments work closely together in tracking climate finance contributions to ensure that Canada's climate finance accurately represents a comprehensive view of all relevant financial flows.

Canada is committed to continuous improvement and strengthening of its climate finance transparency and tracking, recognizing the importance of promoting good reporting practices, strengthening accountability and effectively informing global climate action. Canada works with international partners, including the OECD, to improve its climate finance measurement and reporting. Further information is available on Canada's climate finance website

21 Calculated based on OECD stats on MDB imputed climate shares in 2017. 2018 shares are assumed constant from 2017 levels, in the absence of 2018 data at the time of this report.

22 EDC is a self-financing crown corporation that operates at arm's length from the Government of Canada.

(http://www.canada.ca/international-climate-finance). Users can access project-level information by searching through keyword, region, priority area or contribution year.

More information on the methodologies used for reporting Canada's climate finance can be found in Annex 3.2.

6.2 Technology and Capacity-Building Support

Over 2017 and 2018, Canada continued to support developing countries in addressing the effects of climate change and meet their Nationally Determined Contributions (NDCs). Canada effectively leveraged multilateral channels to promote capacity-building efforts with developing country partners, against the backdrop of Canada's G7 Presidency (2018) and as G20 Energy Ministerial co-chair (2018), where Canada emphasized the importance of technology transfer and capacity building in accelerating the transition to a low carbon future.

Over the course of the reporting period, Canada undertook several new and additional activities to support developing countries build capacity and respond to technological needs expressed by developing country partners. These activities included both mitigation and adaptation efforts, with a focus on emissions reductions, energy efficiency, forestry and land-use planning, and clean electricity.

6.2.1 Technology and Transfer Support

In 2018, Canada undertook several activities in developing countries related to technology transfer for both mitigation and adaption efforts. In the context of the support provided to developing countries for the implementation of their NDCs, as part of Canada's $2.65 billion climate finance commitment, Canada is providing technical expertise through its federal labs toward the mitigation of short-lived climate pollutants.

Through the International Energy Agency (IEA) and the Clean Energy Ministerial (CEM), Canada, with other countries in the International Smart Grids Action Network's (ISGAN) Annex 5: The Smart Grid International Research Facility Network (SIRFN), is also building endogenous climate change adaptation capacity in Mexico by collaborating with Mexico's National Institute of Electricity and Clean Energy (INEEL) to develop a common certification software platform for device testing through the SIRFN.

As an expert in forestry and land-use management, the Canadian Forest Service (CFS) regularly collaborates with partners in other countries to help them understand how forest management could contribute to climate change adaptation and help reduce GHG emissions and increase carbon storage. This includes providing various countries with the Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3), which can be adapted for application to their forest ecosystems. It also includes providing the Generic Carbon Budget Model (GCBM), a tool that is based on the science of the CBM-CFS3 but allows its users to examine the impact of forest management on carbon in a spatially-explicit way.

6.2.2 Capacity-Building Support

In 2017 and 2018, Canada used its position and leadership within numerous multilateral organisations to provide capacity-building support.

During the reporting period, Canada increased its leadership within the Clean Energy Ministerial (CEM) and Mission Innovation (MI), two international fora that bring together over 25 countries to accelerate the development and deployment of clean energy technologies. In May 2019, Canada hosted the 10th Clean Energy Ministerial and 4th Mission Innovation Ministerial meetings in Vancouver, British Columbia. In 2018, Canada hosted the Senior Officials Preparatory Meetings of CEM and MI member governments, where Canada supported capacity building through sharing best practices on clean energy policies and programs with major emerging economies.

Through its participation in the CEM's Clean Energy Solutions Centre, Canada continued to grow capacity in energy management by disseminating the RETScreen Expert Clean Energy Management Software tool developed by Natural Resources Canada's CanmetENERGY lab. RETScreen empowers professionals and decision-makers to rapidly identify, assess and optimize the technical and financial viability of potential clean energy projects.

This decision intelligence software platform also allows managers to easily measure and verify the actual performance of their facilities and helps find additional energy savings/production opportunities. RETScreen has helped developing countries significantly reduce costs associated with clean energy projects, as well as with ongoing energy performance analysis. RETScreen continues to be provided to more than 600,000 users free-of-charge and in 36 languages, and includes comprehensive integrated training materials including video training. In 2017-18, Canada led various capacity-building activities around RETScreen in developing countries, including training materials, workshops, and technical support.

Canada also demonstrated its commitment to capacity-building through engagement under the IEA. In 2017, Canada joined a multi-country[23] launch of the IEA Clean Energy Transitions Programme (CETP), to which Canada pledged $1 million over four years. The Programme provides technical support to governments whose energy policies will significantly impact the speed and prospects for a global transition toward more sustainable energy production and use, including reductions in GHG emissions in line with the objectives of the Paris Agreement. Key countries of focus include Brazil, China, India, Indonesia, Mexico and South Africa. Through CETP, Canada is also promoting women's participation in the global transition to a low-carbon economy, especially in developing countries.

Outside of multilateral channels, Canada continues to share expertise directly with developing countries in areas including clean energy access, sustainable freight transport, forest management, space cooling, and Carbon Capture Use and Storage and Earth Observation methods for landslide monitoring to assist with mitigation and adaptation efforts. As recognized leader in the provision of driver training to help Canada's commercial fleets lower fuel consumption, operating costs and vehicle emissions, Canada has responded to expressed needs from international governments to collaborate on the delivery of adapted training programs. Throughout 2017-2018, Canada delivered training programs and workshops in Brazil and Jamaica to share expertise and build local capacity in sustainable freight transport.

Between 2015 and 2018, Canada provided capacity-building to India in the area of landslide assessment and monitoring using satellite Earth Observation Data. This contributed to India's goal of reducing risk from unstable terrain in various parts of the country where landslide hazards regularly cause considerable damage and deaths. Canada transferred its state-of-the-art techniques to India to enhance understanding of how satellite Earth Observation (using Canada's RADARSAT-2 radar data) can be used to contribute to hazards assessment, mitigation and risk reduction.

In 2018 Canada invested $4 million through the International Development Research Centre to support research and capacity building in developing countries to foster effective, long-term climate action to reduce social inequality, promote greater gender parity, and empower women and girls. This investment supported six projects in Argentina, Bangladesh, Benin, DR Congo, Nepal, and Nigeria.[24]

Canada has also been sharing its world-class expertise in Carbon Capture, Utilization and Storage (CCUS) through trilateral, multi-stakeholder workshops involving representatives from the U.S. and Mexico. These workshops aim to raise awareness of CCUS expertise and achievements, deepen linkages between stakeholders, and provide opportunities to learn from each other's experiences. The most recent workshop was held September 20-21, 2018, in Mexico City, which followed a workshop on March 28-30, 2017, held at Carnegie Mellon University in Pittsburgh, organized by the US Department of Energy.

23 The other countries included: Australia, Denmark, Finland, the European Commission, Germany, Italy, Japan, New Zealand, the Netherlands, Sweden, Switzerland, and the United Kingdom

24 See CTF table 'Provision of Capacity-Building Support' for further details.

7.0 OTHER REPORTING MATTERS

7.1 Domestic Arrangements for Self-Assessment of Emissions Reductions

Canada has established several processes that can help support self-assessment of progress toward emission reduction goals.

Domestic Audit and Review

On behalf of the Auditor General of Canada, the Commissioner of the Environment and Sustainable Development (CESD) is mandated to provide objective, independent analysis and recommendations on the federal government's efforts to protect the environment and foster sustainable development. The Commissioner conducts performance audits and reviews and has responsibility to assess whether federal government departments are meeting their sustainable development objectives, including on climate change.

CESD reports, audits and reviews are tabled in Parliament and provide observations and recommendations for initiatives or areas that require improvement. In addition to arrangements at the federal level (which also apply to Canada's three northern territories), provinces also have their own respective arrangements to audit the effectiveness of environmental policies and programs.

In addition, Canada's *Federal Sustainable Development Act* (the Act) provides a legal framework for developing and implementing a Federal Sustainable Development Strategy that makes environmental decision-making transparent and accountable to Parliament. The Act requires the development of a Strategy every three years, providing a whole-of-government view of federal actions to achieve environmental sustainability, including progress on GHG emission reductions. Performance measurement and reporting is an essential part of the strategy, and indicators to track progress at the goal and target level are drawn largely from the Canadian Environmental Sustainability Indicators (CESI).

The CESI publishes data and interpretation to track Canada's performance on key environmental sustainability issues including climate change and greenhouse gas (GHG) emissions. Data and information sources include Canada's National Inventory Report and the presentation allows for easy comprehension by citizens and decision-makers while providing technical background and links to the sources.

Progress Reports on the Federal Sustainable Development Strategy are also tabled in Parliament at least once every three years, with the most recent 2018 Progress Report on the 2016-2019 FSDS tabled in Parliament in December 2018. The 2019-2022 Federal Sustainable Development Strategy was tabled in June 2019. Amendments to the Act will come into force December 1, 2020 through *An Act to amend the Federal Sustainable Development Act*. These amendments will shift the focus of the Act from an environmental focus to one of sustainable development decision-making, and expand the number of federal organizations required to contribute to the development of the strategy and report on its progress (from 26 to more than 90 organizations).

UNFCCC Transparency Requirements

Accurate and transparent reporting of Canada's GHG emissions and removals are a requirement under the UNFCCC. This reporting, includes Canada's National Inventory Report as well as its National Communications and Biennial Reports, and allows Canada to assess its progress in reducing emissions and combatting climate change. In addition to biennial reporting to the UNFCCC, in non-Biennial Report years Canada publishes supplementary analysis and projections of its GHG emissions in the context of its 2020 and 2030 emissions targets. Most recently, this information was published in 2018 as Canada's Greenhouse Gas and Air Pollutant Emission Projections.

Progress in implementing Canada's domestic Climate Change Plan

A key commitment in Canada's domestic plan, the Pan-Canadian Framework on Clean Growth and Climate Change, is to report annually on progress in implementing the Framework. The Second Annual Synthesis Report on the Status of Implementation was published in December 2018 and the third report is expected shortly.

7.2 Other Information

In recent years, Canada has also established a number of external expert advisory bodies to provide analysis and recommendations to the Government on climate change mitigation and related issues. These include:

Just Transition Task Force

Canada is committed to supporting Canadian workers and communities in the transition to a low carbon economy, alongside direct efforts to reduce emissions. For example, Canada created the independent Task Force on Just Transition for Canadian Coal Power Workers and Communities in 2018 to obtain expert advice on ways to support workers and communities affected by the move from coal to cleaner electricity. The Task Force travelled across Canada to meet directly with coal workers, their families, communities, and labour representatives in order to hear their issues, ideas, and advice. In March 2019, Canada released the Task Force's final report, which included 10 recommendations for a just and fair transition away from coal.

Canada has responded with $185 million in dedicated funding programs for infrastructure, skills development and economic diversification in Canada's coal regions, including creating local transition centres. Canada also committed to work with those affected to explore new ways to protect wages and pensions, and will continue to engage with provinces, workers, unions, municipalities and economic development agencies during this period of transition. Investments in renewable energy, discussed in Chapter 4, also support these efforts.

Advisory Council on Climate Action

Canada appointed the Advisory Council on Climate Action in November 2018 to seek external advice on additional opportunities to reduce carbon pollution in the transportation and building sectors (i.e., beyond measures outlined in the Pan-Canadian Framework). With its work concluding in May 2019, this external advisory body provided an interim report on measures to accelerate the adoption of electric vehicles; Canada subsequently announced programming for electric vehicles consistent with these recommendations, as outlined in Chapter 4. The Council's final report, released in May 2019, provided advice on developing a broader market for building retrofits and on opportunities for the electrification of transport.

Expert Engagement Initiative

Following an open call for proposals under the Expert Engagement Initiative on Clean Growth and Climate Change, Canada is supporting the successful applicant in forming a new and independent not-for-profit 'institute' focused on clean growth and climate change. The Pan-Canadian Expert Collaboration, the applicant that will form the institute, represents more than 15 diverse and reputable organizations across Canada. This new Institute will generate, communicate and mobilize trusted information, research, advice, and best practices to Canadians, governments, and stakeholders. The institute will be supported by highly credible and inclusive research, analysis, and engagement with leaders, experts, and practitioners from across Canada. Expected to launch in early 2020, this institute will help fulfil Canada's commitment under the Pan-Canadian Framework to engage external experts to assess the effectiveness of its measures and identify best practices.

Sustainable Finance

In 2018, Canada's Minister of Environment and Climate Change and Minister of Finance jointly appointed an Expert Panel on Sustainable Finance to consult with financial market participants on issues related to sustainable finance, including climate-related financial disclosures, and to present the Government with potential next steps to consider. The Expert Panel engaged with hundreds of stakeholders from the financial sector, industry, governments, regulators, think tanks and academia. The Panel's final report, *Mobilizing Finance for Sustainable Growth*, was delivered in June 2019, presenting a package of practical, concrete recommendations focused on spurring the essential market activities, behaviours and structures needed to bring sustainable finance into the mainstream.

ANNEX 1 POLICIES AND MEASURES

Summary of Policies and Measures by Sector (CTF Table 3)

This table provides information on core mitigation measures planned or already implemented by federal, provincial, and territorial governments, including those committed to under the Pan-Canadian Framework on Clean Growth and Climate Change. Policies and measures are presented in accordance with Canada's economic sector categories, with cross-cutting measures appearing first. Within the sectoral groupings, federal measures appear first, followed by provincial and territorial measures from west to east. Priority has been given to those policies and measures that have the most significant impact on sectoral GHG emissions. As much as possible direct mitigation impacts have been estimated for key policies, provided by the implementing entity. Where mitigation estimates were not provided, Canada has indicated the reason why they were not included (see notation legend). For example, mitigation estimates were not provided for measures that are still under development, and/ or for those measures where it is difficult to estimate the direct mitigation impact, such as for supporting measures.

Name of Mitigation Action	Sector(s) Affected	GHG(s) Affected	Objective and/or Activity Affected	Type of Instrument	Status of Implementation	Start year of Implementation	Implementation Entity	Estimate of Mitigation Impact in 2020 (Kt CO_2 eq)	Estimate of Mitigation Impact in 2030 (Kt CO_2 eq)
CROSS-CUTTING									
Carbon Capture and Storage Investment (Budget 2008)*	Cross-cutting	CO_2	Support the SaskPower Boundary Dam clean energy technology project	Economic	Implemented	2014	Natural Resources Canada	700	700
Brief Description	As part of Budget 2008, a one-time allocation of $240 million was given towards the SaskPower Boundary Dam carbon capture and storage project which will capture and store up to 1,000 Kt CO_2 per year from 2014 onwards for the life of the plant.								
Clean Energy Fund (Budget 2009)*	Cross-cutting	CO_2	Support the Quest carbon capture and storage facility; and the Alberta Carbon Trunk Line carbon capture, utilization and storage project	Economic	Implemented	Quest 2015/ACTL 2020	Natural Resources Canada	2,700	2,700
Brief Description	As part of Budget 2009, Natural Resources Canada provided $120 million to the Quest project and $63 million to the Alberta Carbon Trunk Line (ACTL) project. Quest, a large-scale and fully integrated carbon capture storage (CCS) project located in Alberta, is the first commercial-scale project of this nature to tackle carbon emissions in the oil sands. ACTL is a 240km pipeline with a capacity of up to 15 million tonnes of CO_2 per year that will link CO_2 from industrial sites near Edmonton for enhanced oil recovery and geological storage in central Alberta. The ACTL is expected to start up in early 2020.								

Name of Mitigation Action	Sector(s) Affected	GHG(s) Affected	Objective and/or Activity Affected	Type of Instrument	Status of Implementation	Start year of Implementation	Implementation Entity	Estimate of Mitigation Impact in 2020 (Kt CO_2 eq)	Estimate of Mitigation Impact in 2030 (Kt CO_2 eq)
Clean Fuel Standard**	Cross-cutting	CO_2, CH_4	Reduce GHG emissions from fuels used in transportation, buildings and industry	Regulatory	Planned	2022 for the liquid class regulations, 2023 for the gaseous and solid class regulations	Environment and Climate Change Canada	NA[b]	30,000
Brief Description	In November 2016 the Government of Canada announced that it would consult with provinces and territories, Indigenous Peoples, industries, and non-governmental organizations to develop a Clean Fuel Standard to reduce Canada's GHGs through the increased use of lower carbon fuels and alternative technologies. A draft regulatory framework was published in December 2017, and based on stakeholder feedback, a phased approach was undertaken, with liquid fuel class regulations being developed first, followed by gaseous and solid fuel class regulations. In June 2019, a Proposed Regulatory Approach for the Clean Fuel Standard was released, presenting the full regulatory design for the liquid fuel class regulations, building on the draft regulatory framework (published December 2017) and developed with extensive stakeholder consultation. The Proposed Regulatory Approach was open for stakeholder comment until August 26, 2019, and work, including stakeholder engagement, on the regulatory design for the gaseous and solid fuel class regulations is ongoing. Draft regulations for the liquid fuel class will be published in early 2020. Final regulations are planned for early 2021, coming into force in 2022. Draft regulations for the gaseous and solid fuel class will be published mid-2021.								
The Clean Growth Program*	Cross-cutting	CO_2, CH_4, N_2O	Improve environmental performance of Canada's natural resources sectors	Economic	Implemented	2017	Natural Resources Canada	NA[b]	500
Brief Description	Under the Clean Growth program, the Government of Canada is providing $155 million over four years to co-fund 50 research, development, and demonstration projects in Canada's energy, mining, and forestry sectors through trusted partnerships with provinces and territories. The program is helping to accelerate emerging clean technologies toward commercial readiness, reduce environmental impacts, enhance competitiveness, and create jobs. The program addresses pressing environmental challenges and economic opportunities facing Canada's natural resource operations in five areas: reducing greenhouse gas and air-polluting emissions; minimizing landscape disturbances and improving waste management; the production and use of advanced materials and bioproducts; efficient energy use and productivity; and reducing water use and impacts on aquatic ecosystems. To better leverage investments, the program promotes and requires collaboration with the provinces and territories. The program is expected to result in direct reductions of GHG emissions of 0.3 Mt to 0.7 Mt per year starting in 2026 (dependent on projects received, success of projects and on-going operation at full production capacity). Oil and Gas Clean Technology Program listed under Oil and Gas below is funded out of this program.								

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Energy Innovation Program*	Cross-cutting	CO_2, CH_4, N_2O	Achieve environmental benefits from technology and/ or new policies, codes and standards	Economic	Implemented	2016	Natural Resources Canada	282	4,000
Brief Description	The Energy Innovation Program (EIP) provides ongoing funding for innovative clean energy research, development and small-scale demonstrations to meet Canada's climate change objectives. EIP uses a range of flexible tools and program streams including grants, contributions, federal/provincial/territorial collaborations and public-private partnerships, such as Breakthrough Energy Solutions Canada (Natural Resources Canada, Breakthrough Energy and Business Development Bank of Canada) and *Canadian Emissions Reduction Innovation Network* (Natural Resources Canada and Alberta Innovates) to engage a range of stakeholders and spur clean energy solutions. In the near-term, the program focuses on technologies with the potential for replication and adoption prior to 2030 in buildings, electricity, transportation and industry. To date, the EIP has supported 63 external grants and contribution projects and 60 federal projects focused on addressing innovation gaps and opportunities to reduce GHGs in key areas such as renewable energy, smart grids, energy-efficient buildings, carbon capture use and storage, and cleaner production of oil and gas. In addition to supporting competitiveness for the transition of Canada's energy sectors, EIP is expected to deliver long term reductions in GHG emissions (10,000-16,000 Kt including direct and indirect reductions).								
Federal Energy Efficient Equipment and Appliances Program*	Cross-cutting	CO_2, CH_4, N_2O	Improve standards for equipment and appliances	Regulatory	Implemented	2016	Natural Resources Canada	3,320	9,700
Brief Description	Since 2016, this program published four omnibus amendments to the *Energy Efficiency Regulations*, updating or introducing minimum energy efficiency standards for nearly 50 product categories. During this period, the program has also updated or introduced high performance ENERGY STAR specifications for 25 product categories. The program also works with provincial and territorial governments and industry stakeholders to encourage market transformation in three equipment areas: windows, space heating and water heating. The Market Transformation Road Map outlines long-term aspirational goals for minimum energy performance by 2030/2035 and serves as the basis for short- to medium-term activities by governments and stakeholders.								

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Carbon pollution pricing across Canada*	Cross-cutting	CH_4, CO_2, N_2O, HFCs, PFCs, SF_6, NF_3	Reduce GHG emissions, stimulate investments in low-carbon innovation and create a sustainable clean growth economy	Regulatory, Economic	Implemented	2019	Environment and Climate Change Canada, Finance Canada	33,000 to 37,000[1]	61,000 to 85,000[1]
Brief Description	In October 2016, the Prime Minister announced the Pan-Canadian Approach to Pricing Carbon Pollution (the federal stringency requirements), which gave provinces and territories the flexibility to develop their own carbon pollution pricing system and outlined criteria all systems must meet to ensure they are stringent, fair, and efficient. The federal government also committed to implementing a federal carbon pollution pricing system in provinces and territories that request it or do not have a carbon pollution pricing system that meets the federal stringency requirements. The *Greenhouse Gas Pollution Pricing Act* established the framework for the federal carbon pollution pricing system. Pursuant to the Act, adopted on June 21, 2018, the federal carbon pollution pricing system has two parts: a trading system for large industry, also known as the Output-Based Pricing System, and a regulatory charge on fossil fuels (fuel charge). The *Output-Based Pricing System Regulations* were published in Canada Gazette Part II on July 10, 2019.								
Federal GHG Offset System (Budget 2019)	Cross-cutting	CH_4, CO_2, N_2O, HFCs, PFCs, SF_6, NF_3	Reduce GHG emissions / enhance removals across Canada from activities not covered by carbon pollution pricing	Regulatory	Planned	2021	Environment and Climate Change Canada	NA[e]	NE[e]
Brief Description	As announced in Budget 2019, the federal government is developing a Federal GHG Offset System to encourage cost-effective domestic GHG emissions reductions or removal enhancements from activities that are not covered by carbon pollution pricing, in sectors such as forestry, agriculture and waste. The federal GHG offset system will build on the recommendations in the Pan-Canadian GHG Offsets Framework for the design of offset systems agreed by the *Canadian Council of Ministers of the Environment* in November 2018.								

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Generation Energy	Cross-cutting	CH_4, CO_2, N_2O, HFCs, PFCs, SF_6, NF_3	Identify pathways to a low-carbon energy future	Information, Education	Implemented	2017	Natural Resources Canada	NA[d]	NA[d]
Brief Description	In 2017, Canada launched Generation Energy, a dialogue about Canada's energy future. Over 380,000 Canadians participated in the dialogue, including through sessions targeted at Indigenous groups, women, students, industry and academics. As part of the dialogue, the Generation Energy Council was established. Their report, released in June 2018, identified pathways that could collectively lead to the affordable, sustainable energy future desired by Canadians. This work supported the subsequent development of a new vision for Canada's energy future, which was announced at the 10th Clean Energy Ministerial and 4th Mission Innovation meetings hosted by Canada in May 2019. The advice continues to inform Canada's path to a clean energy future through saving energy, powering clean communities, using more renewable fuels, and powering the world.								
Greening Government Operations	Cross-cutting	CO_2, CH_4, N_2O	Reduce greenhouse gas emissions from federal buildings, adopt low carbon solutions for federal fleets	Fiscal; Information; Education	Implemented	2017	Treasury Board Secretariat, Natural Resources Canada	NE[a]	80
Brief Description	This ongoing program provides enhanced technical support and a one-stop window to Government of Canada organizations seeking ambitious greenhouse gas emission reduction actions from their building and fleet operations. This will support federal organizations to meet commitments to lead by example, including the target of reducing emissions from federal operations by 40% below 2005 levels by 2030 or earlier and by 80% by 2050. For 2017-18, the most recent reporting year, GHG emissions had been reduced by 32% compared with the 2005 baseline.								
Green Municipal Fund	Cross-cutting	CO_2, CH_4	Support increased energy efficiency in the built environment, which will in turn contribute to reduced GHG emissions	Economic	Planned	2019	Environment and Climate Change Canada, Natural Resources Canada, Infrastructure Canada	NA[e]	NA[e]
Brief Description	Budget 2019 proposed $950 million in new funding for the Federation of Canadian Municipalities (FCM) to support increased energy efficiency in the built environment through the following four initiatives: Sustainable Affordable Housing Innovation ($300 million), Community Ecoefficiency Acceleration ($300 million) and LC3-FCM Collaboration on Community Climate Action ($350 million).								

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Impact Canada Initiative-Clean Technology Stream	Cross-cutting	CO_2, CH_4, N_2O	Unlock breakthrough clean technology solutions to complex and persistent problems	Economic	Planned	2017	Natural Resources Canada	NE[f]	NE[f]
Brief Description	In Budget 2017, Canada allocated $75 million over four years to create the Clean Technology stream of Impact Canada, a new initiative to help focus and accelerate efforts toward solving Canada's big challenges, such as helping Canada's northern and remote communities reduce their reliance on diesel as a power source. Six challenges have been launched under this initiative: The Women in Cleantech Challenge, the Sky's the Limit Challenge, the Power Forward Challenge, the Crush It! Challenge, the Indigenous Off-Diesel Initiative, and the Charging the Future Challenge.								
Improving Access to Capital for CleanTech Companies	Cross-cutting	CH_4, CO_2, N_2O, HFCs, PFCs, SF_6, NF_3	Help Canada's clean technology firms grow and expand	Economic	Planned	2017	Export Development Canada; Business Development Canada	NE[f]	NE[f]
Brief Description	The Government of Canada committed $1.4 billion in new financing in 2017 through the Business Development Bank of Canada (BDC) and Export Development Canada (EDC). This financing includes $950 million in growth capital to support clean technology producers ($700 million by BDC and $250 million by EDC). It also includes approximately $450 million to EDC in additional project financing for "first of kind commercial scale" clean technology projects. EDC has approved one project under this financing, and is working to approve additional clean technology projects. To mobilize its allocated financing, BDC allocated $600 million of this funding to launch its Cleantech Practice in 2018 to support the growth and expansion of future Canadian global technology companies with transactions that exceed BDC's normal risk appetite, and a further $100 million in line with BDC's normal risk parameters. The Cleantech Practice helps high-potential clean technology firms expand by providing them with the capital they need to hire new staff, develop products, support sales, and scale up and compete globally. To date, BDC has invested $175 million of that amount via the Cleantech Practice, and is broadly on target to meet its timelines to allocate the funding to transactions. BDC has already surpassed $100 million for its investment support in line with its normal risk parameters. To date, EDC has approved $32 million out of the $450 million project finance amount, with a number of additional projects in due diligence. EDC has also surpassed its target of $250 million of working capital support to cleantech firms, having approved $1.66 billion in transactions, mostly utilizing internal funding.								
Investing in Canada Infrastructure Program	Cross-cutting	CH_4, CO_2, N_2O	Support GHG mitigation initiatives linked to public infrastructure	Economic	Planned	2018	Infrastructure Canada	NE[e]	NE[e]
Brief Description	The Green Infrastructure-Climate Change Mitigation sub-stream of the Investing in Canada Infrastructure Program (ICIP) will invest at least $3.8 billion in projects that increase generation of clean energy, increase capacity to manage more renewable energy, improve the energy efficiency of eligible buildings, increase access to clean energy transportation, and reduce reliance on diesel in rural and remote communities. The program aims to achieve a national 10 Mt reduction of greenhouse gas emissions. Provinces and territories are required to invest a minimum of 45% of their allocation under the $9.2 billion Green Infrastructure stream in climate change mitigation projects. All ICIP projects above an appropriate threshold—regardless of the stream—will be subject to a Climate Lens, which will require assessment of GHG emissions and/or resilience to climate impacts. Projects funded under ICIP will be undertaken in collaboration with provinces and territories, so project impacts may also appear under provincial programs.								

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Climate Action Incentive Fund	Cross-cutting	CO_2, CH_4, N_2O	Decrease energy usage and reduce carbon pollution	Economic	Implemented	2019	Environment and Climate Change Canada	NE[g]	NE[g]
Brief description	The Climate Action Incentive Fund is a new federal program. In each province that does not meet the federal stringency requirements, the direct proceeds from the federal regulatory charge on fuel – that are not returned directly to individuals and families through Climate Action Incentive payments – provide support to schools, hospitals, small and medium-sized businesses, colleges and universities, municipalities, not-for-profits, and Indigenous communities in the province.								
Climate Action Fund	Cross-cutting	CO_2, CH_4, N_2O	Raise awareness of climate change and build capacity to increase climate actions	Economic	Implemented	2019	Environment and Climate Change Canada	NE[d]	NE[d]
Brief description	In August 2018, Canada launched the Climate Action Fund to help increase action and raise awareness of climate change. Since 2018, the Climate Action Fund has awarded up to $3 million per year to support innovative ideas. The Climate Action Fund provides funding to support projects delivered by students, youth, Indigenous Peoples and organizations, small and medium-sized businesses, not-for-profit organizations, and research and educational institutions. Funded projects will raise awareness of climate change and clean growth and encourage others to take action in support of Canada's climate goals. To date, Canada has approved 44 active projects, totaling $5.3 million.								
Low Carbon Economy Leadership Fund	Cross-cutting	CO_2, CH_4, N_2O	GHG emissions reduction and removals in sectors across Canada	Economic	Implemented	2017	Environment and Climate Change Canada	NE[a]	3,376
Brief Description	Launched in June 2017, the Government of Canada's Low Carbon Economy Fund includes the Low Carbon Economy Leadership Fund, which is providing up to $1.4 billion to provinces and territories that have adopted the Pan-Canadian Framework. This funding recognizes the key role provinces and territories play in implementing the Pan-Canadian Framework and addressing climate change. Provinces and territories were each eligible to receive $30 million plus funding based on population. To date, Environment and Climate Change Canada has approved 48 active projects and funding of approximately $1 billion. Some of the Leadership Fund projects are provincial and territorial programs that further redistribute funding to a large number of projects.								
Low Carbon Economy Challenge	Cross-cutting	CO_2, CH_4, N_2O, HFCs	GHG emissions reduction and removals in sectors across Canada	Economic	Implemented	2017	Environment and Climate Change Canada	NE[a]	2,357
Brief Description	Launched in March 2018, the Government of Canada's Low Carbon Economy Challenge is part of the Low Carbon Economy Fund. It is providing over $500 million to leverage Canadian ingenuity to reduce GHGs and generate clean growth in support of the Pan-Canadian Framework. While funding decisions continue to be made, funded projects are supporting provinces and territories, municipalities, Indigenous communities and organizations, businesses, and not-for-profit organizations. To date, Environment and Climate Change Canada has approved 96 active projects and funding over $414 million.								

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Northern Responsible Energy Approach for Community Heat and Electricity (REACHE) program	Cross-cutting	CO_2	Reduce reliance on diesel in remote Indigenous communities	Economic	Implemented	2016	Crown-Indigenous Relations and Northern Affairs Canada	NE[a]	NE[a]
Brief Description	The Government of Canada allocated $53.5 million over ten years and $5.4 million ongoing to continue the Northern Responsible Energy Approach for Community Heat and Electricity Program (Northern REACHE) to reduce reliance on diesel for heat and electricity in rural and remote Indigenous communities. As of September 2017 the program has funded 48 projects to reduce reliance on diesel including: energy efficiency, renewable energy, and capacity building projects.								
Regulation of Hydrofluorocarbons*	Cross-cutting	HFCs	Reduce emissions of HFCs	Regulatory	Implemented	2019	Environment and Climate Change Canada	1,000	9,000
Brief Description	In October 2016, Parties to the Montreal Protocol, including Canada, adopted an HFC phase-down amendment (the Kigali Amendment) wherein developed countries will begin in 2019 to gradually phase down the consumption of HFCs to 15% of calculated baseline levels by 2036. Canada's *Ozone-depleting Substances and Halocarbon Alternatives Regulations* were amended in October 2017, implementing this phase-down. Following this, Canada ratified the Kigali Amendment in November 2017. Canada's regulatory amendments entered into force in April 2018, and the phase-down began in January 2019 with a 10% consumption reduction. The regulatory amendments combine a phase-down of production and imports of HFCs with prohibitions on the manufacture and import of products containing or designed to contain HFCs.								
Strategic Innovation Fund	Cross-cutting	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	Promote innovation including to reduce GHGs and other environmental impacts	Economic	Implemented	2019	Innovation, Science and Economic Development Canada	NE[f]	NE[f]
Brief Description	The Strategic Innovation Fund, created in 2017, supports large-scale, transformative projects to promote research and development, clean growth, and the advancement of Canada's innovation ecosystem. The Strategic Innovation Fund is open to all sectors of the Canadian economy, including clean-tech projects. In 2019, the Government of Canada announced $100 million over four years to the Strategic Innovation Fund, leveraging private sector co-investments, in order to support the activities of the Clean Resource Innovation Network. This Network, a consortium of businesses, innovators, not-for-profits, and academic institutions, is working to accelerate the development and adoption of innovative technologies and processes to lower the oil and gas industry's environmental impacts.								

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Sustainable Development Technology Canada	Cross-cutting	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	Support pre-commercial development and demonstration of clean technology projects	Economic	Implemented	2001	Sustainable Development Technology Canada	NA[f]	NA[f]
Brief Description	Sustainable Development Technology Canada (SDTC) is a foundation created by the Government of Canada to support Canadian companies in their efforts to develop and demonstrate new environmental technologies that address climate change, clean air, clean water and clean soil. The Government of Canada has also provided funding to a number of other clean technology related programs, including $400 million in 2017 to recapitalize SDTC's Sustainable Development Tech Fund. Sustainable Development Technology Canada subsequently approved 62 new projects designed to develop and demonstrate new clean technologies that promote sustainable development. As of March 31, 2019, SDTC has allocated $1.15 billion to support 397 projects across Canada, leveraging an additional $2.93 billion in public and private sector investment, since its establishment in 2001. SDTC-supported technologies have generated an estimated 18.1 megatonnes of CO_2 eq annual emissions reductions, $3.05 billion in annual revenues and 13,107 direct and indirect jobs. SDTC-supported projects have also contributed to an estimated $208.8 million of cost avoided through the benefits of cleaner air, water and soil.								
British Columbia Carbon Tax*	Cross-cutting	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	Reduce GHG emissions from fossil fuel use	Economic	Implemented	2008	British Columbia	4,600	5,600
Brief Description	This tax applies to virtually all fossil fuels, including: gasoline, diesel, natural gas, coal, propane, and home heating fuel. The carbon tax started at a rate based on $10 per tonne of associated carbon or carbon-equivalent emissions, and is currently set at $40/tonne CO_2 eq. British Columbia's carbon tax will increase by $5 per tonne per year until it reaches $50/t.								
British Columbia CleanBC Program for Industry*	Cross-cutting	CH_4, N_2O, CO_2,	Reduce GHG emissions from industry	Economic	Adopted	2019	British Columbia	NE[h]	2,500
Brief Description	British Columbia will direct a portion of B.C.'s carbon tax paid by industry into incentives for cleaner operations. Eligibility is based on a facility's performance against a world-leading benchmark.								
British Columbia Renewable Natural Gas Requirement*	Cross-cutting	CO_2	Reduce GHG emissions from industry	Regulatory	Planned	2020	British Columbia	NE[h]	2,400
Brief Description	British Columbia will make industrial natural gas consumption cleaner with a minimum 15% to come from renewable gas.								

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British Columbia Innovative Clean Energy Fund	Cross-cutting	CO_2	Support advancement of clean energy technologies	Economic	Implemented	2008	British Columbia	NE[h]	NE[h]
Brief Description	The Innovative Clean Energy Fund is funded through a levy on energy sales, designed to support the Province's energy, economic, environmental and greenhouse gas reduction priorities, to advance BC's clean energy sector. Since 2008, the Innovative Clean Energy Fund has committed approximately $97 million to support pre-commercial clean energy technology projects, clean energy vehicles, research and development, and energy efficiency programs.								
British Columbia Carbon Neutral Government Program and Carbon Neutral Capital Program	Cross-cutting	CO_2	Achieve carbon neutrality in government operations	Regulatory	Implemented	2007	British Columbia	NE[h]	NE[h]
Brief Description	The *Greenhouse Gas Reduction Targets Act* required the provincial government, including provincial ministries and agencies, schools, colleges, universities, health authorities and Crown corporations, to become carbon neutral by 2010 and to make public a report every year detailing actions taken towards carbon neutrality. The province has achieved carbon neutrality for its public sector operations each year from 2010 to 2018. For the 2018 reporting year, overall public sector organization emissions were 7.8% lower than they were in 2010.								
British Columbia *GHG Emission Control Regulation*	Cross-cutting	CO_2, CH_4	Reduce GHG emissions	Regulatory	Implemented	2016	British Columbia	NE[h]	NE[h]
Brief Description	The *Greenhouse Gas Emission Control Regulation* establishes the infrastructure and requirements for issuing emission offset units and funded units. These are the foundational elements that enable compliance with the performance standards listed within a Schedule to the *Greenhouse Gas Industrial Reporting and Control Act*. The Regulation also establishes the BC Carbon Registry, which enables the electronic issuance, transfer and retirement of compliance units (emission offset units, funded units and earned credits). BC's *GHG Industrial Reporting and Control Act*, and associated regulations such as this one, apply carbon pricing requirements to liquefied natural gas and coal-fired electricity generation (in addition to the provincial carbon tax).								

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Alberta Large Emitter Greenhouse Gas Regulations **2007-2017:** ***Specified Gas Emitters Regulation**** **2018-2019:** ***Carbon Competitiveness Incentive Regulation**** **2020-forward:** ***Technology Innovation and Emissions Reduction (TIER)*** **Regulation***	Cross-cutting	CH_4, CO_2, HFCs, N_2O, NF_3, PFCs, SF_6	Reduce the emissions intensity of large emitters	Economic	Implemented	2007	Alberta	14,000	20,000
Brief Description	Alberta has regulated greenhouse gas emissions from large industry since 2007 with a focus on those sites emitting more than 100,000 tonnes of CO_2 eq annually. These entities represent approximately half of the province's emissions. The newly enacted *Technology Innovation and Emissions Reduction (TIER)* regulation requires that most facilities to reduce their emissions intensity by 10% from a facility-specific baseline based on past emissions and production, however electricity facilities must comply with a sector-wide benchmark of 0.370 tonnes of CO_2 per megawatt hour. Regulated facilities have four compliance options: improve the GHG intensity of their operations; buy emissions performance credits from other regulated facilities that achieve reductions beyond their requirement; buy Alberta-based offsets; or pay $30 per tonne of CO_2 eq to the Climate Change and Emissions Management Fund. The price trajectory has been $15/tonne for 2007 through 2015, $20/tonne for 2016, and $30/tonne for 2017 forward. Note that estimated mitigation impacts are relative to 2015 projections and also include the impacts of measures such as: renewable electricity program; carbon capture, use and storage; coal phase-out; and, methane regulations.								
Alberta Carbon Capture, Storage and Utilization*	Cross-cutting	CO_2	Enable government support for carbon capture and storage projects	Economic	Implemented	2008	Alberta	NA[c]	NA[c]
Brief Description	This Large Emitter legislation (SGER, CCIR and now TIER) has enabled Alberta to administer funding to support large-scale carbon capture, utilization and storage (CCUS) projects. Two large-scale CCUS projects currently receive funding from the Government of Alberta: The Quest CCS project and the Alberta Carbon Trunk Line (ACTL) Enhanced Oil Recovery (EOR) project. Beginning in 2015, the Quest project captures and geologically stores over 1 Mt CO_2 per year from Shell's Scotford Oil Sands Upgrader. By the end of 2020, the ACTL project will capture approximately 1.2 Mt of CO_2 from the North West Redwater Refinery and approximately 0.3 Mt of CO_2 per year from the Nutrien Fertilizer Facility. The captured CO_2 will then be injected into a mature oil field, now an approved enhanced oil recovery scheme, and will be permanently stored. To date, the Government of Alberta has committed $1.24 billion in funding for these two CCUS projects. The 2020 estimate of mitigation impact is included under the Large Emitter Regulations. These emission reductions are not listed to avoid double counting since these CCUS projects' emission reductions are listed by the federal government (Clean Energy Fund).								

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Alberta Emission Offset Protocols*	Cross-cutting	CO_2, CH_4, N_2O	Enhance removals and reduce emissions	Economic	Implemented	2018	Alberta	4,500	4,500
Brief Description	Alberta continues to support the generation of voluntary emission offsets in various sectors such as agriculture, renewable energy, waste management, and oil and gas. Emission offsets are available as a regulatory compliance option for large industrial emitters under the *Carbon Competitiveness Incentive Regulation* (to be replaced by the *Technology Innovation and Emissions Reduction Regulation*). Alberta continues to explore opportunities for protocol development under its protocol development process.								
Saskatchewan *Management and Reduction of Greenhouse Gases Act*	Cross-cutting	CH_4, CO_2, HFCs, N_2O, PFCs, SF_6	Enable the implementation of emissions management	Regulatory	Implemented	2018	Saskatchewan	NE[h]	NE[h]
Brief Description	*The Management and Reduction of Greenhouse Gases Act (MRGHG Act)* was partially proclaimed and in force since January 1, 2018. Amendments to MRGHG Act were made in late 2018 to: • Revise existing prescriptive provisions related to GHG reporting and methodology; • Enable intensity-based performance standards for large emitters; • Enable compliance mechanisms for use by large emitters, including a technology fund, a provincial offset system and best performance credits; and, • Enable the implementation of performance standards on large industrial emitters. The amended *MRGHG Act* was proclaimed in full in December 2018.								
Saskatchewan Offset Credit System	Cross-Cutting	CH_4, CO_2, HFCs, N_2O, PFCs, SF_6	Create a market for emissions reductions and sequestration activities	Economic	Planned	2021	Saskatchewan	NE[b]	NE[h]
Brief Description	Saskatchewan intends to develop and implement an offset system that creates additional value for actions that result in carbon sequestration or reduced emissions, especially from soils and forests. Offset credits created in the system may be used as a compliance mechanism by large industrial emitters to meet regulated GHG performance standards.								

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Saskatchewan *Regulation Respecting the Management and Reduction of Greenhouse Gases (General and Reporting)*	Cross-Cutting	CH_4, CO_2, HFCs, N_2O, PFCs, SF_6	Regulate reporting of GHG emissions	Regulatory	Implemented	2018	Saskatchewan	NE[h]	NE[h]
Brief Description	These reporting regulations require all emitters of more than 10,000 tonnes of CO_2 eq annually to report emissions. The additional data will help produce a more robust provincial GHG inventory and allow Saskatchewan to efficiently target and reduce sources of GHG emissions in the province.								
Saskatchewan SaskPower Demonstration and Implementation of Carbon Capture Technology*	Cross-cutting	CO_2	Reduce GHG emissions from coal energy	Voluntary Agreement, Research	Implemented	2014	Saskatchewan	NA[c]	NA[c]
Brief Description	With funding support from the federal government, Saskatchewan has invested upwards of $17 million in capture and storage projects and projects that reduce flaring. Together with industry and government partners, it has several capture and storage projects underway, including the Aquistore project and the Carbon Capture Test Facility. The Weyburn-Midale project is the largest capture and storage demonstration site in the world. Saskatchewan is continuing to fund research related to the Weyburn reservoir through the Saskatchewan CO_2 Oilfield Use for Storage and EOR Research Project. Saskatchewan has implemented the approximately $1.35 billion, 115 megawatt project at Boundary Dam, with a $240 million federal government contribution. The Boundary Dam facility began commercial operation in October 2014 and is expected to capture up to 1 Mt of CO_2 per year until the facility's end of life, reducing emissions by 7.2% from 2002 levels. These emission reductions are not listed to avoid double counting since the Boundary Dam emission reductions are listed by the federal government (Carbon Capture and Storage Investment – Budget 2008). Saskatchewan has been injecting carbon dioxide into the subsurface since 1984.								
Efficiency Manitoba Act* and Energy Savings Targets	Cross-cutting	CO_2, CH_4, N_2O	Reduce energy use	Regulatory	Implemented	2018 (legislation) and 2020 (programming)	Manitoba	NE[h]	NE[h]
Brief Description	In 2018, the *Efficiency Manitoba Act* was established and the province established Efficiency Manitoba, a new Crown corporation with the sole purpose of administering and delivering energy savings cost-effectively to consumers. As per the *Efficiency Manitoba Act*, Manitoba must meet legislated savings targets of 22.5% of domestic electricity demand (an average of 1.5% annually of domestic electricity consumption) and 11.25% of domestic natural gas demand (an average of 0.75% annually of natural gas consumption) over a 15-year period. Until energy efficiency programming begins in 2020 by Efficiency Manitoba, Manitoba Hydro continues to deliver energy efficiency programs.								

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Manitoba Carbon Savings Account	Cross-cutting	CO_2, CH_4, HFCs, N_2O, NF_3, SF_6	Reduce GHG emissions	Regulatory	Implemented	2018	Manitoba	NE[h]	NE[h]
Brief Description	Manitoba is the first jurisdiction in North America to establish an economy-wide carbon savings account, settings its emissions reduction goal for 2018-2022 in June 2019 ahead of the November regulatory deadline. The carbon savings account for 2018-2022 is based on the recommendations of the independent Expert Advisory Council, including its emission reduction target of 1 Mt of CO_2 eq. cumulative emission reductions from 2018 to the end of 2022. Five-year carbon savings accounts will continue to be set, as required in *The Climate and Green Plan Act*, to drive emission reductions in a timely and sustained manner.								
Ontario Energy Efficiency Standards for Products and Appliances and Equipment	Cross-cutting	CO_2, CH_4, N_2O	Reduce GHG emissions in the residential, commercial and industrial sectors	Regulatory	Implemented (and new proposed)	Regulation has been in place since 1989. Standards in place for over 80 products with implementation dates ranging from 1993 to 2021	Ontario	NE[h]	NE[h]
Brief Description	Ontario's regulation *O. Reg. 509/18* sets efficiency requirements for over 80 products using electricity, natural gas, and oil in the residential, commercial and industrial sectors. Ontario is working on its next update to O. Reg. 509/18 that would increase efficiency standards for major fuel burning appliances/equipment while harmonizing efficiency requirements with the federal government standards.								
Ontario Provincial Land Use Plans and Legislation	Cross-cutting	CO_2	Permanently protect prime agricultural land and environmental sensitive areas	Regulatory/ Policy	Implemented	Various	Ontario	NE[h]	NE[h]
Brief Description	Originally published in 2006 and updated in 2019 as the "A Place to Grow: the Growth Plan for the Greater Horseshoe," the Growth Plan for the Greater Golden Horseshoe, the Greenbelt Plan, the Oak Ridges Moraine Conservation Plan and the Niagara Escarpment Plan are four provincial land use plans that work together to manage growth, build complete communities, curb sprawl and protect the natural environment. Ontario's land use plans are enabled by key legislation. The *Places to Grow Act (2005)* enables the development of regional growth plans that guide government investments and land use planning policies. The *Greenbelt Act (2005)* allows for the designation of an area of land as the Greenbelt Area—lands protected from development.								
Ontario's Emissions Reduction Fund	Cross-cutting	CH_4, CO_2, HFCs, N_2O, NF_3, PFCs, SF_6	Establish an emissions reduction trust to support and encourage investments for initiatives that reduce GHGs	Economic	Planned	TBD	Ontario	NE[e]	NE[e]
Brief Description	Ontario is proposing to launch an emissions reduction fund to encourage private investment in clean technology solutions. Ontario is planning to commit funding of $400 million over four years and establish an independent board to identify projects that will reduce emissions and drive investments in clean technologies.								

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Québec acquisition, implementation and commercialization of equipment and technologies that enable businesses, including SMEs, to reduce their GHG emissions	Cross-cutting	CO_2	Reduce GHG emissions in small and medium enterprises	Voluntary Agreement	Implemented	2018	Québec	10.4	NE[h]
Brief Description	The objective of the program is to increase the productivity and competitiveness of companies in different industrial sectors that wish to reduce their GHG emissions, to accelerate the commercialization of innovations from clean technology companies and ultimately to reduce the carbon footprint of industrial activities in Québec.								
Québec's Cap-and-Trade System for Greenhouse Gas Emission Allowances*	Cross-cutting	CH_4, CO_2, HFCs, N_2O, NF_3, PFCs, SF_6	Reduce GHG emissions across the economy	Economic	Implemented	2013	Québec	NE[c]	NE[c]
Brief Description	The Québec government's cap-and-trade system for greenhouse gas emissions has been in operation since 2013 and has been fully linked to California's system since 2014. The Québec system covers industry, electricity production and imports as well as fuel distribution, which together account for about 85% of Québec's GHG emissions. Offset protocols are also in place in sectors not covered by the system. By the end of 2019, Québec and California will have held a total of twenty-one joint auctions of GHG emission allowances. Ontario's cap-and-trade system was linked with that of Québec and California from January to June 2018, but was then cancelled. Estimation of mitigation impact in 2020 and 2030: Caps for 2020 have been set on a declining linear trajectory to help achieve Québec's GHG emission target of 20% below 1990 levels, caps from 2021 to 2030 have been similarly set from 55.26 Mt CO_2 eq in 2021 to 44.14 Mt CO_2 eq in 2030 to help achieve Québec's target of 37.5% below 1990 levels in that year.								
Québec EcoPerformance Program*	Cross-cutting	CO_2, HFCs	Reduce GHG emissions	Economic	Implemented	2013	Québec	913	NE[h]
Brief Description	The Ecoperformance program is available to businesses, institutions and municipalities. Both small and large energy consumers can apply for financial assistance. The program aims to improve the energy efficiency of commercial and institutional buildings as well as that of industrial processes in order to reduce fugitive and regular GHG emissions in processes and to diminish the consumption of fossil fuels. In addition to direct reductions projected in the short term, indirect, longer term mitigation impacts are also expected.								
Québec *Regulation Respecting Halocarbons*	Cross-cutting	HFCs	Reduce halocarbon emissions	Regulatory	Planned	2020	Québec	NE[c]	NE[c]
Brief Description	The *Regulation respecting halocarbons* came into effect in 2004. Proposed amendments to this regulation are currently under review. The amendments propose a partial ban on HFCs and aim to encourage the adoption of new technologies. They also specify the standards related to the recycling of halocarbons, the actions to be taken in the event of leakage and the treatment of used halocarbons. The mitigation impact of this measure is included in the estimate for the federal measure Regulation of Hydrofluorocarbons.								

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Québec Technoclimat Program	Cross-cutting	CH_4, CO_2, HFCs, N_2O, NF_3, PFCs, SF_6	Develop new innovative technologies or processes in the areas of energy efficiency	Economic	Implemented	2013	Québec	NE[h]	NE[h]
Brief Description	The objective of Technoclimat is to encourage the development, in Québec, of technological innovation in the areas of energy efficiency, renewable energies, bioenergies and GHG emission reductions by offering financial assistance to project promoters who wish to demonstrate the potential of technological innovation. It also promotes the testing in Québec of technologies that are either unavailable or not widely available in the Québec market.								
New Brunswick *Energy Efficiency Act* and Regulations	Cross-cutting	CO_2	Improve efficiency standards for products sold within the province	Regulatory	Implemented	1992	New Brunswick	NE[h]	NE[h]
Brief Description	Reduce GHGs by increasing the minimum level of efficiency of products (appliances and equipment) sold in the province.								
Nova Scotia Cap-and-Trade Program*	Cross-cutting	CH_4, CO_2, HFCs, N_2O, NF_3, PFCs, SF_6	Reduce GHG emissions across Nova Scotia's economy	Regulatory	Implemented	2019	Nova Scotia	170	NE[h]
Brief Description	As part of the Pan-Canadian Framework on Clean Growth and Climate Change, Nova Scotia implemented a cap-and-trade program which covers approximately 80% of GHG emissions in the province. Estimation of mitigation impact in the first compliance period from 2019 to 2022 is a cumulative total of at least 650 Kt CO_2 eq.								
Prince Edward Island Climate Change Action Plan**	Cross-cutting	CO_2, CH_4, N_2O	Reduce emissions and increase climate resilience	Voluntary Agreement	Planned	2018	Prince Edward Island	NE[h]	180
Brief Description	Prince Edward Island has developed a Climate Change Action Plan. This plan will help the province reduce emissions and better prepare for a changing climate. It includes commitments in five areas and 32 action items to be completed over a five-year period (2018-2023). PEI also recently adopted a new 2030 GHG target–40% below 2005 levels. A Special Standing Committee on Climate Change, with representatives from all three parties in PEI's government, will be struck to assess plans to further reduce greenhouse gas emissions to meet the new, more ambitious target.								

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Prince Edward Island *Climate Leadership Act**	Cross-cutting	CO_2	Reduce the use of fossil fuels for heating and transportation	Regulatory	Implemented	2019	Prince Edward Island	NE[h]	NE[h]
Brief Description	Prince Edward Island is administering a carbon levy in the province, and the federal government is administering the federal output-based system for large emitters. The carbon levy is administered through the *Climate Leadership Act* and began applying on April 1, 2019. The price started at $20/tonne in 2019 and will increase in increments of $10/ tonne/year until the price reaches $50/tonne. First Ministers committed to reviewing carbon pollution pricing across Canada in 2022 with an interim review in 2020. PEI will participate in this review. PEI will continue efforts to implement the Climate Change Action Plan (May 2018).								
Prince Edward Island Energy Strategy	Cross-cutting	CO_2	Reduce energy use and develop renewable energy	Voluntary Agreement	Adopted	2016 / 2017	Prince Edward Island	NE[h]	NE[h]
Brief Description	Prince Edward Island has developed a 10-year energy strategy to reduce energy use, establish cleaner and locally produced energy sources and moderate future energy price increases. The Strategy is guided by three principles: lowering greenhouse gas emissions, cost-effectiveness, and creating local economic opportunities.								
Prince Edward Island Take Charge Public Education Campaign	Cross-cutting	CO_2	Reduce emissions from residential homes and vehicles	Education	Implemented	2023	Prince Edward Island	NE[b]	NE[h]
Brief Description	In March 2019, the province launched the Take Charge: Action for Climate Change campaign (takechargeforclimate.com). This informational website and multi-media campaign provides Islanders with information about climate change and its impact, while inspiring individuals and families to make changes in their day-to-day lives that contribute to climate solutions.								
Newfoundland and Labrador carbon pricing*	Cross-cutting	CH_4, CO_2, N_2O, HFCs, PFCs, SF_6, NF_3	Implement a carbon pricing system to reduce GHG emissions from all sectors of the economy	Regulatory	Implemented	2019	Newfoundland and Labrador	NE[c]	NE[c]
Brief Description	Newfoundland and Labrador's carbon pricing system for greenhouse gas emissions came in to force on January 1, 2019 and covers over 90% of GHG emission in the province (some covered emissions are exempted within the program). It conceptually mirrors the federal approach by applying a carbon tax "at the pump" and implementing performance standards for large industrial facilities. This system is expected to allow the province to make progress toward its 2020 GHG reduction target (to reduce GHGs by 10% below 1990 levels) and 2030 GHG reduction target (to reduce GHGs by 30% below 2005 levels).								

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Northwest Territories GHG Grant Program	Cross-cutting	CO_2	Provide support for energy efficiencies over and above the fiscal capacity of Arctic Energy Alliance	Fiscal	Implemented	2019	Northwest Territories	NE[h]	118
Brief Description	The Northwest Territories launched the GHG Grant Program, with support from Environment and Climate Change Canada. The program provides fiscal support to various recipients including Indigenous, municipal and Territorial Governments; businesses; non-profits; and individual building owners, whom implement a project that reduces GHG emissions within the Northwest Territories.								
Nunavut new district heating systems	Cross-cutting	CO_2	Reduction of fossil fuel consumption	Voluntary Agreement	Implemented	2018	Nunavut's Utility (Qulliq Energy Corporation)	0.82	7.37
Brief Description	The communities of Sanikiluaq and Taloyoak, in Nunavut, will benefit from a new district heating system that will help reduce the territory's fuel consumption and cut carbon emissions. The project, funded by the Government of Canada's Low Carbon Economy Fund, captures residual heat from power generation and provides space and hot water heating to nearby commercial and institutional buildings, allowing customers to save on energy costs and extend the life of their heating equipment. Feasibility studies estimate that a new district heating system in Sanikiluaq and Taloyoak will displace approximately 298,000 litres of fuel and reduce emissions by 830 tonnes of CO_2 annually.								
ELECTRICITY									
Clean Energy for Rural and Remote Communities*	Electricity	CO_2	Reduce consumption of diesel fossil fuels	Economic	Implemented	2018	Natural Resources Canada	NA[a]	138
Brief Description	This is a Green Infrastructure program under the Investing in Canada Plan. The program provides up to $220 million in funding for renewable energy projects in rural and remote communities to reduce their reliance on diesel and other fossil fuels. Activities include deployment of new renewable energy technologies, demonstration of innovative clean energy solutions, support for the development of bioheating projects, and capacity building. Funding for more than 70 projects was allocated through two funding streams targeting projects and capacity building.								
ecoENERGY for Renewable Power Program*	Electricity	CO_2	Reduce GHG emissions by increasing renewable electricity supply in Canada	Economic	Implemented	2007	Natural Resources Canada	6,000	6,000
Brief Description	The program offers an incentive of 1 ¢ per kilowatt-hour of electricity produced over a period of ten years from qualifying low-impact renewable energy projects built before March 31, 2011.								

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Emerging Renewable Power*	Electricity	CO_2	Support deployment of emerging renewable power projects	Economic	Implemented	2018	Natural Resources Canada	NA[a]	227
Brief Description	This is a Green Infrastructure program under the Investing in Canada Plan. The $200 million Emerging Renewable Power Program was launched in February 2018 to support the deployment of emerging renewable energy technologies and to expand the portfolio of commercially viable renewable energy sources available to provinces and territories as they work to reduce GHG emissions from their electricity sectors. The call for proposals launched on February 26, 2018 and closed on April 20, 2018. Four projects have since been announced; with $29.8 million funding for an instream tidal project in the Bay of Fundy, Nova Scotia, $25.6 million for a deep geothermal project near Estevan Saskatchewan, $15.3 million for a solar project near Suffield Alberta and $25.4 million for a deep geothermal project in the Municipal District of Greenview.								
Reduction of CO_2 Emissions from the Amendments to the Coal-Fired Generation of Electricity Regulations*	Electricity	CO_2	Reduce GHG emissions from coal-fired electricity generation	Regulatory	Implemented	2015 (with amendments in 2018)	Environment and Climate Change Canada	NA[b]	12,800
Brief Description	Regulations under the *Canadian Environmental Protection Act (1999)* apply a performance standard to new coal-fired electricity generation units and to existing units once they reach a defined period of operating life (generally 45-50 years). Amendments to the *Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations*, which were finalized and published in the Canada Gazette, Part II on December 12, 2018, require all coal-fired electricity generating units to comply with an emissions performance standard of 420 tonnes of carbon dioxide per gigawatt hour of electricity produced (tonnes of CO_2/GWh) by 2030, at the latest. This performance standard is designed to phase out conventional coal-fired electricity by the end of its operating life, or by 2030, whichever comes first.								
Regulations Limiting CO_2 Emissions from Natural Gas-Fired Electricity*	Electricity	CO_2	Limit GHG emissions from natural gas-fired electricity	Regulatory	Implemented	2019 for boiler units 2021 for combustion engine units	Environment and Climate Change Canada	NE[c]	NE[c]
Brief Description	The *Regulations Limiting Carbon Dioxide Emissions from Natural Gas-fired Generation of Electricity* were finalized and published in the Canada Gazette, Part II on December 12, 2018. The regulations for natural gas-fired electricity ensure that new natural gas-fired electricity generation uses efficient technology. The regulations will encourage companies to convert their coal units to natural gas ahead of their end-of-life under the amended coal regulations, while also providing assurance that higher emitting coal-to-gas converted units will be phased out more rapidly than better performers.								

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Smart Grid program*	Electricity	CO_2	Support the deployment of integrated smart grid systems and the demonstration of promising, near-commercial smart grid technologies	Economic	Implemented	2018	Natural Resources Canada	NA[a]	900
Brief Description	The program will invest up to $100 million to accelerate the transition to a clean growth economy by better utilizing the existing capacity of electricity assets, increasing the penetration of renewable generation, increasing the reliability, resiliency, and flexibility of the power system while maintaining cyber security, and reducing GHG emissions. Twenty projects have been selected to receive funding under this program. This is a Green Infrastructure program under the Investing in Canada Plan.								
Strategic Interconnections of Electricity Grids*	Electricity	CO_2	Support large clean electricity generation and transmission projects that significantly reduce GHG emissions	Economic	Implemented	2018	Infrastructure Canada, Canada Infrastructure Bank, Natural Resources Canada	NE[b]	3,500
Brief Description	The program provides financial support to large clean electricity generation and transmission projects that can transmit clean electricity from provinces and regions with abundant renewable energy resources to provinces and regions seeking to reduce reliance on fossil fuels for electricity generation. Negotiations on Integrated Bilateral Agreements began in fall 2017 and concluded in October 2018; Infrastructure Bank became operational in 2018. Several projects are underway. Under the $9.2 billion Green stream of the Investing in Canada Infrastructure Program, delivered through Integrated Bilateral Agreements, there has been one publically announced strategic interconnection project to date. This electrification project underway in British Columbia is entitled the Peace Region Electricity Supply, and will connect the existing LNG industry to renewable energy to power their processes. As modelled in the Regional Electricity Cooperation and Strategic Infrastructure reports, this project has the potential to reduce 2.6Mt of greenhouse gases in 2030.								
Additional Interconnections of Electricity Grids**	Electricity	CO_2	Support large clean electricity generation and transmission projects that significantly reduce GHG emissions	Economic	Planned	2019	Infrastructure Canada, Canada Infrastructure Bank, Natural Resources Canada	NE[b]	2,500
Brief Description	The program provides financial support to large clean electricity generation and transmission projects that can transmit clean electricity from provinces and regions with abundant renewable energy resources to provinces and regions seeking to reduce reliance on fossil fuels for electricity generation. Negotiations on Integrated Bilateral Agreements began in fall 2017 and concluded in October 2018; Infrastructure Bank became operational in 2018. Several additional projects are planned.								

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British Columbia *Clean Energy Act*: Clean or Renewable Electricity Requirement*	Electricity	CO_2, CH_4	Maintain low carbon electricity supply	Regulatory	Implemented	2010	British Columbia	NE[h]	NE[h]
Brief Description	British Columbia continued to exceed its target of 93% clean electricity, with 98% generated from clean sources in 2018. BC amended the *Greenhouse Gas Reduction (Clean Energy) Regulation* to support the development of additional transmission infrastructure in northeast BC to provide clean electricity to meet increasing demand from the upstream natural-gas sector.								
British Columbia *Clean Energy Act*: Demand Side Management	Electricity	CO_2	Reduce emissions from utilities consumers	Regulatory	Implemented	2010	British Columbia	75	75
Brief Description	British Columbia amended the *Greenhouse Gas Reduction (Clean Energy) Regulation* to allow utilities to take demand-side measures to encourage customers to switch from higher-emission fuels to clean electricity. The provincial electricity utility BC Hydro is required to meet 66% of its forecasted incremental electricity demand through demand side management. BC also amended the Demand-Side Measures Regulation to allow utilities to double energy efficiency programs for natural gas-fired equipment.								
Alberta Coal-Fired Electricity Generation phase-out*	Electricity	CO_2	Phase out the use of coal as a source of electricity by 2030	Regulatory	Planned	TBD	Alberta	NE[c]	NE[c]
Brief Description	As part of Alberta's Climate Leadership Plan announced in 2015, pollution from coal-fired sources of electricity will be phased out completely by 2030. Estimate of mitigation impact in 2030 is included in Large Emitter Greenhouse Gas Regulations impacts.								
Alberta Renewable Electricity Program*	Electricity	CO_2	Increase renewable energy capacity	Economic	Implemented	2017	Alberta	NE[c]	NE[c]
Brief Description	The Renewable Electricity supported development of 1100 megawatts of renewable electricity capacity to be connected to the Alberta grid system by 2021. The program was run through a series of competitions in 2017 and 2018 to incent the development of renewable electricity generation through the purchase of renewable attributes. Estimate of mitigation impact in 2020 and 2030 is included in Large Emitter Greenhouse Gas Regulations impacts.								

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Saskatchewan *Regulation Respecting the Management and Reduction of Greenhouse Gases (General and Electricity Producer)*	Electricity	CO_2	Reduce emissions from electricity generation	Regulatory	Implemented	2018	Saskatchewan	NE[c]	NA[c]
Brief Description	The *Management and Reduction of Greenhouse Gases (General and Electricity Producer) Regulations* came in force January 1, 2018. The regulations impose a greenhouse gas emissions cap on coal and gas-fired electricity generators in the province (namely SaskPower), and impose a minor reporting obligation on independent power producers. In June 2019, an equivalency agreement for coal-fired electricity regulations between Saskatchewan and Canada was finalized. The agreement enables SaskPower to manage a decrease in the use of coal on a fleet-wide basis, rather than on a facility basis, and will supplant federal regulations effective January 1, 2020. The mitigation impact of this measure is included in the estimate for the federal measure *Reduction of CO_2 Emissions from the Amendments to the Coal-Fired Generation of Electricity Regulations*.								
SaskPower Programs	Electricity	CO_2, CH_4	Increase carbon neutral generation	Voluntary Agreement	Adopted	2018	Saskatchewan	NE[h]	NE[h]
Brief Description	In October 2018, SaskPower introduced the new Power Generation Partner Program (PGPP) to replace the existing Small Power Producers and Flare Gas Power Generation Programs. The PGPP is a 2-year program accepting up to 10 MW of renewable generation and 25 MW of carbon-neutral non-renewable generation from customer and community owned projects each year. In November 2018, SaskPower's Net Metering Program was extended until November 30, 2021 or such a time when the program reaches 16 MW of new generation, whichever occurs first. The 16 MW cap for the net metering program was reached in mid-2019 due to a rapid increase in program participation. A modified Net Metering Program was subsequently launched in November 2019 with no limit on program capacity and no program end date. The new program creates certainty and a sustainable incentive for increased renewable energy in the province.								
SaskPower Electricity Initiatives*	Electricity	CO_2	Reduce GHG emissions from electricity generation and enhance supply of renewables	Voluntary Agreement	Implemented	2007, 2018	Saskatchewan	NE[h]	NE[h]
Brief Description	SaskPower has a mandate to reduce emissions by 40% below 2005 levels by 2030. SaskPower has also set a target to achieve up to 50% of its generation capacity from renewable sources by 2030, doubling the percentage of renewables in the supply mix in 15 years. Meeting this target would significantly reduce greenhouse gas emissions–about 40% below 2005 levels in 2030. This will include the addition of 60 megawatts of solar generation by 2021 and up to 1,600 megawatts from wind by 2030. These reductions will also be met through carbon capture and storage technology.								

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Manitoba Keeyask Hydro-electricity Project*	Electricity	CO_2, CH_4, N_2O	Increase renewable energy generation (local and export)	Fiscal	On going construction	2020	Manitoba	NE[h]	3,000
Brief Description	Manitoba is constructing the Keeyask generating station, which will add 695 megawatts of renewable electricity capacity in the province by 2021, with its first generator expected to go into service in October 2020. The project will allow for GHG reductions of approximately 3.0 Mt per year in Saskatchewan and US states.								
Manitoba last coal-generating unit phase-out*	Electricity	CO_2, CH_4, N_2O	Phase out of coal-fired generating	Regulatory	Implemented	2018	Manitoba	NA[c]	NA[c]
Brief Description	Brandon Generation Station, which housed the last coal-fired generator in Manitoba, ceased operation of the coal unit ahead of schedule in August 2018, the generator was converted to use as a synchronous condenser in February 2019 providing greater reliability of Manitoba's electrical grid. The phasing-out of coal is expected to reduce annual GHG emissions by 45,000-187,000 tonnes. The mitigation impact of this measure is included in the estimate for the federal measure *Reduction of CO_2 Emissions from the Amendments to the Coal-Fired Generation of Electricity Regulations*.								
Ontario Coal Phase Out*	Electricity	CO_2, CH_4, N_2O	Eliminate coal-fired electricity generation and the associated GHG emissions	Regulatory	Implemented	2003	Ontario	NA[c]	NA[c]
Brief Description	Initiated in 2003, coal-fired electricity was successfully eliminated from all Ontario Power Generation stations by April 2014, 19 generating units in total. In 2018, 93% of Ontario electricity generation came from emissions-free sources. The mitigation impact of this measure is included in the estimate for the federal measure *Reduction of CO_2 Emissions the Amendments to the Coal-Fired Generation of Electricity Regulations.*								
New Brunswick Phase-out Coal-Fueled Electricity Generation	Electricity	CO_2, N_2O	Achieve GHG reductions through elimination of coal fueled electricity, or equivalent	Regulatory	Implemented	2030	New Brunswick	NA[c]	NA[c]
Brief Description	Eliminate coal-fueled electricity generation by 2030, or achieve an equivalent electricity-generation GHG reduction. The mitigation impact of this measure is included in the estimate for the federal measure *Reduction of CO_2 Emissions from the Amendments to the Coal-Fired Generation of Electricity Regulations*.								

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New Brunswick Electricity Act, Renewable Portfolio Standard* Regulation, and Energy Efficiency Mandate	Electricity	CO_2, N_2O	Achieve 40% of renewable energy for electricity sold in New Brunswick	Regulatory	Implemented	2014	New Brunswick	178	NE[h]
Brief Description	The *Electricity from Renewable Resources Regulation* requires 40% of electricity sold in New Brunswick to be from renewable sources by 2020. By 2020, 75% of New Brunswick's electricity demand will be met by non-emitting or renewable sources.								
New Brunswick Output Based Pricing (OBPS) for Industry and Electricity*	Electricity	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3	Improve the carbon intensity of large industry and electricity generation	Regulatory	Planned	TBD	New Brunswick	NE[e]	500
Brief Description	New Brunswick submitted a design for a provincial output-based pricing system to the federal government as part of the annual federal stringency requirement process and requested that the federal government stand down the federal OBPS retroactively as of January 2019. Work in 2020 will be to prepare all appropriate legislation and regulatory requirements for implementing the provincial OBPS.								
Nova Scotia Electricity Sector Regulations*	Electricity	CO_2, HFCs, CH_4, N_2O, SF_6, PFCs	Reduce GHG emissions from the electricity sector and to increase the share of clean energy in the province's energy use	Regulatory	Implemented	2009, 2010, 2013	Nova Scotia	NA[c]	NA[c]
Brief Description	Nova Scotia has implemented two separate regulations to address emissions from the electricity sector and enhance the supply of renewables, which are together expected to result in emission reductions of at least 2,700 Kt CO_2 eq in 2020. The *Greenhouse Gas Emissions Regulations* implement a mandatory declining cap on GHG emissions from electricity generation facilities. From a baseline of 10.2 Mt (2007) the decreases are scheduled in progressive steps so the emissions will decline to 7,500 Kt or below by 2020 and further to 4,500 Kt or below by 2030. Total electricity GHG reduction in Nova Scotia for 2007 to 2030 will be at least 5,700 Kt CO_2 eq. The *Renewable Electricity Regulations* require 40% of electricity supply to be generated from renewable sources by 2020. This will involve the adoption of a diverse mix of energy sources including wind, tidal, solar, hydro and bioenergy. The mitigation impact of this measure is included in the estimate for the federal measure *Reduction of CO_2 Emissions from the Amendments to the Coal-Fired Generation of Electricity Regulations*.								

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Nova Scotia Electricity Efficiency Regulations	Electricity	CO_2	Use energy more efficiently	Regulatory	Implemented	2014	Nova Scotia	NE[c]	NE[c]
Brief Description	Nova Scotia created Canada's first energy efficiency utility, Efficiency Nova Scotia. Since its creation, this independent organization has achieved annual reductions of 1.2% below the business as usual baseline. It also administers comprehensive energy efficiency programs for low income and First Nations Nova Scotians. The *Electricity Efficiency and Conservation Restructuring Act* (2014) requires Nova Scotia Power to purchase efficiency resources whenever they are lower cost than producing power. Efficiency resources are provided by Efficiency Nova Scotia for commercial, industrial, and residential consumers. Targets for electricity efficiency are guided by a periodic Integrated Resource Plan required by the Utility Board. GHG reductions achieved through electricity efficiency are included in the GHG reduction estimates provided for the *Nova Scotia Greenhouse Gas Emissions Regulations.*								
Prince Edward Island Wind Farm Development**	Electricity	CO_2	Develop additional renewable electricity supply	Economic	Planned	2020	Prince Edward Island	NE[h]	22
Brief Description	The PEI Energy Corporation has begun work on the first of two new wind farms; 30 MW in 2020 and 40 MW in 2025-26. Wind regime studies at four locations of interest were completed. Environmental impact analysis studies, Climate Lens Assessments and risk mitigation assessments have been completed for the three most favorable locations.								
Prince Edward Island-New Brunswick Cable Interconnection Upgrade Project*	Electricity	CO_2	Deliver reliable, long-term energy, and balance the growing wind energy supply	Economic	Implemented	2017	Prince Edward Island, New Brunswick	NE[h]	NE[h]
Brief Description	Prince Edward Island (PEI) completed a cable interconnection upgrade within the Northumberland Strait, between the provinces of Prince Edward Island and New Brunswick. Two 180 MW cables will help meet the growing demand for electricity on PEI, deliver reliable, long-term energy for Islanders, and help balance the intermittent nature of growing wind energy supply.								
Prince Edward Island *Renewable Energy Act*	Electricity	CO_2	Pursue cleaner sources of energy and reduce reliance on imported energy	Regulatory	Implemented	2005	Prince Edward Island	NE[h]	NE[h]
Brief Description	The *Renewable Energy Act* established a minimum purchase price utilities must pay for power produced by large-scale renewable energy generators and makes it economically feasible for Island homeowners, small businesses or farmers who have an interest in generating their own electricity to install small-scale generating systems through net-metering. Currently about 25% of Prince Edward Island's electricity consumption is sourced from on-island wind farms.								

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Newfoundland and Labrador Muskrat Falls hydroelectric project*	Electricity	CO_2, CH_4, N_2O	Implement Muskrat Falls hydroelectric project	Economic	Planned	2020	Newfoundland and Labrador	1,400	1,400
Brief Description	This project will allow for the closure of a thermal oil generating facility and will result in 98% of electricity consumption in the province coming from renewable sources. The project will also allow for GHG reductions of at least 1 Mt per year in other provinces such as Nova Scotia. The project is expected to be completed in 2020.								
Newfoundland and Labrador renewable electricity strategy	Electricity	CO_2, CH_4, N_2O	Renewable electricity strategy	Economic	Planned	2019	Newfoundland and Labrador	NE[h]	NE[h]
Brief Description	Building on the Muskrat Falls development which will reduce GHG emissions in Newfoundland and Labrador by 10% once operational, Newfoundland and Labrador announced a renewable energy strategy in 2019 that will, among other items, to increase capacity and demand for renewable electricity in isolated diesel systems in the province's northern, remote and Indigenous communities.								
Yukon Energy Corporation/ ATCO Electric InCharge Program	Electricity	CO_2	Reduce GHG emissions from fossil fuel electricity generation	Voluntary Agreement	Implemented	2014	Yukon	NE[d]	NE[d]
Brief Description	Yukon Energy Corporation and ATCO introduced InCharge in 2014 to promote a culture of electricity conservation in Yukon's residential sector. The initiative consists of three programs; the LED and Automotive Heater Timer Rebate Program, the Low Cost Energy Efficient Products Program and an Engagement, Education and Communication Program. The anticipated annual net savings with transmission and distribution losses is expected to reach 2,644 MWh by 2018. The plan is expected to generate indirect, rather than direct, emissions reductions.								
Yukon Independent Power Production Policy	Electricity	CO_2, CH_4, N_2O	Reduce diesel consumption for electricity and heat generation	Economic	Implemented	2019	Yukon	<1	NE[h]
Brief Description	To assist large scale power producers, the Government of Yukon has adopted the Independent Power Production (IPP) Policy which aims at enabling independent, non-utility electricity producers to sell electricity to Yukon's two public utilities through renewable energy technologies, such as wind power, micro-hydro, biomass and solar electric (or photovoltaic) systems. The IPP policy was fully implemented in January 2019 and three projects were reviewed and approved by July 2019. These projects have a total forecast generation of 10.6 GWh, which is half the generation cap available under the policy's Standing Offer Program. The first project should be operational by mid-2020 and is expected to reduce emissions by 680 tonnes CO_2 eq per year.								

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Yukon Microgeneration Policy	Electricity	CO_2, CH_4, N_2O	Reduce diesel consumption for electricity and heat generation	Economic	Implemented	2014	Yukon	<1	NE[h]
Brief Description	To assist small scale power producers, the Government of Yukon's Microgeneration Policy enables individuals and businesses to install electrical generating systems and connect them to the grid. The electricity generated is consumed on site and any surplus can be sold into the grid. From when it was announced in October 2013, to July 2019, 243 microgeneration systems have been installed which are expected to generate 2.7 GWh per year. The program is expected to deliver direct reductions in the short term, with indirect, longer term impacts expected.								
Northwest Territories Arctic Energy Alliance Outreach	Electricity	CO_2	Educate, raise awareness and help residents adopt energy saving practices	Education	Implemented	2007	Northwest Territories	NE[h]	NE[h]
Brief Description	The Arctic Energy Alliance, a non-profit organization, provides free information, advice, incentives and answers to questions from residents of the Northwest Territories on energy efficiency and hosts annual Energy Actions Awards. The Arctic Energy Alliance also conducts energy audits to educate residents on how to reduce home energy consumption.								
Northwest Territories Capital Asset Retrofit Fund	Electricity	CO_2	To implement energy efficiencies across territorial-owned building and assets	Fiscal	Implemented	2008	Northwest Territories	12.5	20
Brief Description	The Northwest Territories has initiated the Capital Asset Retrofit Fund to improve building efficiency for territorial owned assets through energy audits, building surveys and energy benchmarking.								
Nunavut's Net Metering Program	Electricity	CO_2	Reduction of fossil fuel consumption	Economic	Implemented	2018	Nunavut's Utility (Qulliq Energy Corporation)	NE[h]	NE[h]
Brief Description	Launched on April 10, 2018, this program encourages hamlet and residential customers to install their own renewable energy system and offers energy credits for communities and individuals for feeding energy back into the Qulliq Energy Corporation's energy grid.								

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Nunavut's Independent Power Producer (IPP) Program	Electricity	CO_2	Reduction of fossil fuel consumption	Economic	Planned	Expected Fall 2019	Nunavut's Utility (Qulliq Energy Corporation)	NE[h]	NE[h]
Brief Description	On Nov 8, 2018, Qulliq Energy Corporation (QEC) received approval from the Government of Nunavut to amend the QEC Act to enable the corporation to purchase power from Independent Power Producers (IPPs). QEC is in the process of developing the technical and policy requirements for the program, with an anticipated launch in 2019 once Cabinet approval is received. QEC will pay up to the avoided cost of diesel for any energy produced by an IPP.								
TRANSPORTATION									
Canada's Action Plan to Reduce GHG Emissions from Aviation*	Transportation	CO_2, CH_4, N_2O	Reduce GHG emissions from the aviation sector	Voluntary Agreement	Implemented	2012	Transport Canada	NE[d]	NE[d]
Brief Description	The Action Plan is a comprehensive voluntary approach between Transport Canada and the Canadian aviation industry to reduce the sector's GHG emissions. It sets a target to improve fuel efficiency by an annual average of 1.5% until 2020, measured against a 2008 baseline, and outlines a series of supporting measures. Annual reports are published on Transport Canada's website demonstrating progress under the plan. The Action Plan also forms the basis for the Government of Canada's response to the International Civil Aviation Organization's Assembly Resolution A37-19.								
Carbon Dioxide Standards for Aviation	Transportation	CO_2	Reduce GHG emissions from new airplanes	Regulatory	Planned	2020	Transport Canada	NA[e]	NE[e]
Brief Description	Canada participated in the development of a new international CO_2 standard for new and in-production airplanes through the Committee on Aviation Environmental Protection at the International Civil Aviation Organization (ICAO). ICAO has adopted the new standard and Canada is working towards adopting the new standard into the *Canadian Aviation Regulations* in early 2020.								
Carbon Offsetting and Reduction Scheme for International Aviation	Transportation	CO_2	Reduce carbon emissions from international aviation	Regulatory	Implemented–Stage 1 Planned–Stage 2	Stage 1 - 2019 Stage 2 - 2021	Transport Canada	NE[e]	NE[e]
Brief Description	The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) is an international initiative by the International Civil Aviation Organization (ICAO) that requires operators to acquire and cancel emissions units to offset a portion of their CO_2 emissions from 2021 to 2035. Its role is to complement a broader basket of measures to achieve carbon neutral growth for international aviation from 2020 onwards. Canada is a signatory to CORSIA alongside 192 other member states. CORSIA is a market-based measure requiring affected air operators to purchase eligible emission units on the open market to offset a portion of their emissions. Canada began the monitoring, reporting, and verification portion of CORSIA on January 1, 2019. Regulations for the offsetting component of CORSIA will be completed by 2021.								

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ecoTECHNOLOGY for Vehicles Program	Transportation	CO_2, CH_4, N_2O	Support development of low-emission vehicle regulations, standards, etc.	Research, Information	Implemented	2011	Transport Canada	NE[d]	NE[d]
Brief Description	The ecoTECHNOLOGY for Vehicles program proactively tests, evaluates, and provides expert technical information about the environmental and safety performance of advanced on-road vehicle technologies, including light-duty and heavy-duty vehicles. The program shares technical findings to inform the development of vehicle emission regulations; to guide the proactive development of new or revised safety regulations, standards, codes and guidelines; and to support the development of non-regulatory industry codes and standards to help integrate new clean vehicle technologies into Canada in a safe and timely manner.								
Electric Vehicle Charging and Alternative Fuel Refuelling Infrastructure*	Transportation	CO_2, CH_4, N_2O	Accelerate demonstration and deployment of charging and refuelling infrastructure, and supporting codes and standards	Regulatory	Implemented	2016	Natural Resources Canada	NE[d]	NE[d]
Brief Description	The program supports the demonstration and deployment of electric vehicle (EV) chargers, and alternative fuel (e.g. natural gas, hydrogen) stations along Canada's highways and freight corridors. In addition, it supports the development and revision of enabling codes and standards for electric and alternative fueled vehicles and refuelling infrastructure. This is a Green Infrastructure initiative under the Investing in Canada Plan. The program is an enabling measure that will not directly reduce emissions but will contribute to unlocking larger emissions reductions. As of November 2019, federal infrastructure investments of have resulted in: • 844 EV fast chargers, 207 of which are currently open to the public; • 17 natural gas refueling stations, 7 of which are open to the public; and • 10 hydrogen refueling stations, 2 of which are open to the public. • 3 additional RFPs are planned, additional projects are being solicited. Additionally, the EV Infrastructure Demonstration (EVID) program Phase 1 and 2 is currently supporting 38 real world demonstrations of innovative EV infrastructure technology and solutions that overcome barriers to adoption of EV infrastructure in the urban environment, such as multi-unit residential buildings and for people without dedicated parking, at workplaces and for public transit. An additional 44 EVID project proposals are currently under review from third call for proposal issued in Fall 2019.								

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Energy efficiency of replacement tires	Transportation	CO_2	Reduce GHG emissions from transportation fuels	Regulatory	Planned	2020	Natural Resources Canada	NE[e]	NE[e]
Brief Description	Canada is developing a standard for the energy efficiency of replacement tires. In 2017, tire testing was initiated in collaboration with Transport Canada and the United States National Highway Traffic Safety Administration, which will inform development of the standard. A report containing results from tire testing was released as well as a market study on the domestic tire industry. The tire industry has been engaged and preliminary discussions with standard development agencies have begun. Draft technical standards will be developed by spring 2020, and are planned to be included in Amendment 17 of the *Energy Efficiency Act*, which is expected to be published in Canada Gazette Part I in late 2020.								
Energy Efficient Transportation	Transportation	CO_2, CH_4, N_2O	Improve energy efficiency in transportation in Canada	Information, Education, Regulatory	Implemented	2016	Natural Resources Canada	1,100	1,900
Brief Description	This program has 3 elements: 1) to provide Canadians a suite of information and awareness tools and materials, including the EnerGuide label for vehicles to help consumers choose more fuel efficient vehicles; 2) to operate Canada's SmartWay Partnership program, which helps Canada's commercial/ institutional freight sector benchmark and track their fuel consumption; 3) to promote freight management best practices and accelerate the adoption of energy management best practices in fleets and supply chains.								
Federal *Renewable Fuels Regulations**	Transportation	CO_2	Regulate renewable content in fuel	Regulatory	Implemented	2010	Environment and Climate Change Canada	4,000	NA[d]
Brief Description	The regulations require an average 5% renewable fuel content for gasoline, and 2% renewable fuel content in diesel fuel. Provinces such as Alberta, British Columbia and Ontario also have renewable fuel regulations in their respective jurisdictions. For example, these measures include the *Alberta Renewable Fuel Standard Regulation*, *British Columbia Renewable and Low Carbon Fuel Requirements Regulation*, Saskatchewan Renewable Diesel Program, *Ontario Ethanol in Gasoline Regulation*, and Ontario renewable fuel requirements for gasoline and diesel. Certain other provinces have established incentive programs for renewable fuels, including the Manitoba Biofuel Production Incentive and the Ontario Ethanol Growth Fund.								
Heavy Duty Vehicle GHG Regulations Phase 1*	Transportation	CO_2, CH_4, N_2O	Reduce GHG emissions from the on-road transportation sector	Regulatory	Implemented	2014	Environment and Climate Change Canada	2,600	5,700
Brief Description	These regulations apply increasingly stringent GHG emissions standards to new on-road heavy-duty vehicles and engines of model year 2014 to 2017 imported or manufactured in Canada.								

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Heavy Duty Vehicle GHG Regulations Phase 2*	Transportation	CO_2, CH_4, N_2O	Reduce GHG emissions from the on-road transportation sector	Regulatory	Implemented	2020	Environment and Climate Change Canada	NA[b]	5,800
Brief Description	The amendments to the *Heavy-duty Vehicle and Engines Greenhouse Gas Emission Regulations* were published on May 30, 2018. These regulations apply increasingly stringent GHG emissions standards to new on-road heavy-duty vehicles and engines imported or manufactured in Canada starting with model year 2021. Further, the regulations introduce new GHG emission standards that apply to trailers hauled by on-road transport tractors imported or manufactured in Canada for 2020. The Regulatory Impact Analysis Statement accompanying the regulations indicates $1.6 billion in benefits from fuel savings in 2030.								
Invest in efficient trade and transportation corridors	Transportation	CO_2, CH_4, N_2O	Improve the efficiency of trade and transportation corridors	Economic	Three Calls for Proposals: Implemented Project implementation: Ongoing	First Call for Proposals: 2017 Second Call for Proposals: 2018 Third Call for Proposals: 2019 Project implementation: 2018	Transport Canada	NA[a]	NA[a]
Brief Description	Through the National Trade Corridors Fund (NTCF), the Government of Canada is investing $2.4 billion over 11 years to strengthen the efficiency and resilience of Canada's transportation system by addressing bottlenecks, adding capacity, and improving its ability to adapt to a changing climate. Since 2017, Transport Canada has announced funding for 81 projects through three competitive calls for proposals, with a total cost of $3.6 billion and a federal investment of $1.7 billion. Projects funded by the NTCF are located in every province and territory, and were required to demonstrate their ability to meet the NTCF's overall program objectives, including increasing the resilience of the Canadian transportation system in a changing climate and ensure it adapts to new technologies and future innovation. All applicants were required to include climate change adaptation and resilience assessments and greenhouse gas emissions analysis in their comprehensive project proposals.								
Invest in public transit*	Transportation	CO_2, CH_4, N_2O, HFC	Improve access to public transit in Canada	Economic	Adopted	2016	Infrastructure Canada	NA[d]	NA[d]
Brief Description	The Investing in Canada Plan makes $28.7 billion available for public transit: • The Public Transit Infrastructure Fund committed $3.17 billion to 1,194 projects. • As of November 2019, the Investing in Canada Infrastructure Program, which launched in 2018, has allocated $20.1 billion to advance public transit projects over a decade. To date, the program has committed $7.42 billion to 46 public transit projects. At least $5 billion has been allocated to the Canada Infrastructure Bank for mobility projects, and multiple transit projects have been selected to receive investment. To date the bank has committed over $3.33 billion to advance major rail projects through a range of financing instruments.								

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Light-Duty Vehicle GHG Regulations Phase 1*	Transportation	CO_2, CH_4, N_2O	Reduce GHG emissions from the on-road transportation sector	Regulatory	Implemented	2011	Environment and Climate Change Canada	11,900	23,300
Brief Description	The regulations establish progressively stringent GHG emission standards to new passenger automobiles and light trucks manufactured or imported into Canada for model years 2011-2016.								
Light-Duty Vehicle GHG Regulations Phase 2*	Transportation	CO_2, CH_4, N_2O	Reduce GHG emissions from the on-road transportation sector	Regulatory	Implemented	2014	Environment and Climate Change Canada	2,800	24,300
Brief Description	The regulations establish progressively stringent GHG standards for new vehicles of model years 2017 to 2025.								
Memorandum of Understanding between the California Air Resources Board and Environment and Climate Change Canada	Transportation	CO_2, CH_4, N_2O	Reduce GHG emissions from vehicles	Voluntary Agreement	Implemented	2019	Environment and Climate Change Canada	NA[d]	NA[d]
Brief description	The agreement commits Canada and California to work together on their respective regulations to cut down on greenhouse gas pollution from vehicles like cars, pickup trucks and SUVs, and to work together to promote the uptake of cleaner vehicles. Canada and California will also share best practices and technical information about regulating cleaner fuels.								
Memorandum of Understanding between Transport Canada and Rail Industry for Reducing Locomotive Emissions*	Transportation	CO_2, CH_4, N_2O	Reduce GHG emissions from railway locomotives operated by Canadian railway companies in Canada	Voluntary Agreement	Implemented	2018	Transport Canada	150	600
Brief Description	This Memorandum of Understanding is a Canadian industry-government initiative, covering the 2018-2022 time period. The MOU includes GHG intensity targets for Class I freight, intercity passenger railways and short line railways and also encourages railways to adopt measures and undertake actions to improve GHG emission intensity from rail operations. In addition, the *Locomotive Emission Regulations* under the *Railway Safety Act* came into effect on June 9, 2017, and target criteria air contaminant emissions from locomotives.								

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Meeting Canada's Zero-Emission Vehicle Targets*	Transportation	CO_2, CH_4, N_2O	Reduce GHG emissions from on-road light-duty vehicles and support clean transportation innovation	Economic, Voluntary Agreement	Implemented (Economic) Planned (Voluntary Agreement)	2019	Transport Canada, provincial, territorial, and municipal governments, industry, non-governmental organizations	NE[a]	1,900
Brief Description	In 2019, the Government of Canada set the following sales targets for zero-emission vehicles: 10% of new light-duty vehicle sales by 2025; 30% by 2030; and 100% by 2040. The federal government is pursuing a suite of measures to help put Canada on a path towards meeting these targets. Budget 2019 included $300 million over three years for the creation of a federal Incentives for Zero-Emission Vehicles (iZEV) Program. The iZEV Program launched on May 1, 2019 and provides point-of-sale incentives of up to $5,000 on eligible zero-emission vehicles, which includes plug-in hybrids. To support business adoption of zero-emission vehicles, Budget 2019 also introduced a 100 % tax write-off for eligible vehicles. In addition, work has begun to establish voluntary agreements with Original Equipment Manufacturers, to ensure supply of zero-emission vehicles can meet increased demand in Canada. This work will continue to 2020.								
Retrofit requirements for existing heavy-duty trucks to install fuel-saving devices	Transportation	CO_2	Reduce GHG emissions from existing heavy-duty vehicles	Information / Research	Planned	2018	Transport Canada, provincial and territorial governments	NE[e]	NE[e]
Brief Description	Jurisdictions are taking collective action via a federal, provincial and territorial task force to study opportunities to encourage greater use of fuel saving devices in heavy-duty trucks.								
Zero Emission Vehicle Infrastructure Program*	Transportation	CO_2, CH_4, N_2O	Enabling the deployment of zero emission vehicles	Fiscal	Implemented	2019	Natural Resources Canada	NE[d]	NE[d]
Brief Description	Budget 2019 announced $130 million over 5 years to deploy recharging and refueling stations in workplaces, public parking spots, commercial and multiuse residential buildings and remote locations. These investment were made to support Canada's zero emission vehicle sales targets.								
British Columbia SCRAP-IT Program	Transportation	CO_2, N_2O	Reduce GHGs from transportation	Economic	Implemented	1996	British Columbia	NE[c]	NE[c]
Brief Description	The SCRAP-IT Program, operational on and off since 1996, offers qualifying vehicle owners incentives to take their older vehicles off the road rather than resell them. Incentives are offered to support the purchase of zero emission vehicles and support other low carbon forms of transportation. Emissions reduction estimates for this measure are aggregated into the estimates for another overarching measure.								

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British Columbia Transport Infrastructure Investments	Transportation	CO_2, N_2O	Reduce GHGs from transportation	Economic	Implemented	2016	British Columbia	NE[h]	NE[h]
Brief Description	British Columbia now requires consideration of climate change impacts in transportation infrastructure design plans to improve the province's transportation network and transition to electric drive or low carbon fuels by transitioning to a fully electric bus fleet over two decades and investing in hybrid diesel-electric or dual fuel capable ferries that can run on either liquefied natural gas or ultra-low sulphur diesel.								
British Columbia GHG Reduction Regulation Enabling Utilities to Incent Natural Gas Vehicles*	Transportation	CO_2, N_2O	Reduce GHGs from transportation	Economic	Implemented	2012	British Columbia	NE[h]	NE[h]
Brief Description	The Province implemented the *Greenhouse Gas Reduction (Clean Energy) Regulation* in 2012 that permits utilities to offer incentives for the purchase of natural gas vehicles, and to make investments in liquefied natural gas and compressed natural gas fuelling infrastructure in sectors such as medium and heavy duty on-road transportation, marine, mining, and locomotive support. Amendments were made in 2015 that allow utilities to double the total pool of incentives available to convert commercial fleets to natural gas, when the new incentives go towards vehicles using 100% renewable natural gas. The program will also promote investments in natural gas fuelling stations at customers' facilities.								
British Columbia Fueling Marine Vessels with Cleaner Burning Liquefied Natural Gas	Transportation	CO_2, N_2O	Reduce GHGs from marine transportation	Economic	Planned	2017	British Columbia	NE[h]	NE[h]
Brief Description	Amendments to the *Greenhouse Gas Reduction Regulation* to allow utilities to provide further incentives for marine bunkering of liquefied natural gas. Emission reductions are expected to occur outside the jurisdiction when used by international vessels. However, this program is also targeting domestic vessels, such as ferries and support vessels in the ports.								

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British Columbia Supporting Zero Emission Vehicle Charging Infrastructure*	Transportation	CO_2, N_2O	Reduce GHGs from transportation	Regulatory, Economic	Implemented	2017	British Columbia	NE[h]	NE[h]
Brief Description	The BC government is expanding support for the development of electric vehicle (EV) charging stations in buildings across the province by ensuring regulations allow local governments to require new buildings to install adequate infrastructure to support electric vehicle charging and developing policies. It is also exploring regulatory/legislative changes that would give strata property owners the right, with limited exceptions, to charge EVs at home. The Charging Incentives and Solutions Program provided incentives towards the cost of the purchase and installation of eligible electric vehicle charging equipment and support services for planning and installing electric vehicle chargers. Budget 2019 announced $20 million to support the creation of new public fast-charging and hydrogen fueling stations, an additional $5 million for incentives for the installation of home and workplace charging stations, and $5 million invested by government in charging stations at highway rest areas and buildings owned by the province. A corporate supply arrangement has been established to streamline public procurement of electric vehicle charging stations. This arrangement allows the provincial public sector, Indigenous and non-Indigenous communities to purchase electric vehicle charging stations directly from suppliers, often with favourable pricing. It covers either supply and/or installation of the charging station.								
British Columbia Renewable and Low Carbon Fuel Requirements*	Transportation	CH_4, CO_2, N_2O	Reduce GHG from transportation fuels	Regulatory	Implemented	2008	British Columbia	NE[h]	4,400
Brief Description	British Columbia continues to implement its renewable and low carbon fuel policy. The Regulation requires a minimum renewable fuel content for the fuel supplied in British Columbia (5% for gasoline, 4% for diesel) and requires fuel suppliers to reduce the average carbon intensity of transportation fuels by 20% by 2030.								
British Columbia Clean Energy Vehicles Program*	Transportation	CO_2, N_2O	Reduce GHGs from transportation	Economic	Implemented	2011	British Columbia	NE[h]	300
Brief Description	British Columbia continues to build upon its commitment to support clean energy vehicle uptake and charging infrastructure deployment through incentive programs, an evolving regulatory framework, fleets programs, and outreach and training. The program from December 2011-March 2014 provided incentives for eligible clean energy vehicles and included deployment of charging point infrastructure for these vehicles. Phase 2 of the Clean Energy Vehicles Program began in April 2015 with similar incentives, and the program received further funding in 2016-17 and 2019 to support continued point-of-sale purchase incentives of up to $3,000 for battery electric vehicles, longer range plug-in hybrids, or hydrogen fuel cell electric vehicles. British Columbia also offers incentives of up to $50,000 for specialty-use vehicles such as zero emission buses and heavy-duty vehicles. British Columbia will also expand incentives for buses, medium- and heavy-duty vehicles, port and airport equipment and marine vessels.								

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British Columbia Zero Emissions Vehicle Mandate*	Transportation	CO_2, N_2O	Reduce GHGs from transportation	Regulatory	Adopted	2019	British Columbia	NE[h]	1300
Brief Description	British Columbia has passed the *Zero-Emission Vehicles Act* to phase in targets for the sale of zero-emission vehicles (ZEVs). This legislation sets targets of 10% ZEV sales by 2025, 30% by 2030, and 100% by 2040, while government will take additional steps to make ZEVs more affordable.								
British Columbia Increased Supply of Renewable Fuels	Transportation	CO_2, N_2O	Reduce GHGs from transportation	Economic, Education, Fiscal, Information, Regulatory, Research, Voluntary Agreement	Planned	2020	British Columbia	NE[h]	NE[h]
Brief Description	British Columbia will increase the supply of cleaner fuels by ramping up new production in BC of 650 million litres of renewable gasoline and diesel by 2030.								
British Columbia Tailpipe Emissions Standards*	Transportation	CO_2, N_2O	Reduce GHGs from transportation	Regulatory	Planned	2025	British Columbia	NE[b]	400
Brief Description	British Columbia will make vehicles run cleaner by increasing tailpipe emissions standards for vehicles sold after 2025.								
Alberta GreenTRIP	Transportation	CO_2	Increase accessibility and use of public transit in Alberta	Economic	Implemented	2010	Alberta	NE[h]	NE[h]
Brief Description	GreenTRIP helps provide Albertans with a wider range of sustainable public transit alternatives for local, regional and inter-municipal travel, making public transit more accessible. It also helps reduce traffic congestion by lowering the number of single occupancy vehicles on Alberta roads and provides people with broader transportation options.								
Saskatchewan Freight Strategy	Transportation	CO_2	Reduce emissions from freight transportation	Voluntary Agreement	Planned	2020	Saskatchewan	NE[h]	NE[h]
Brief Description	Saskatchewan will create a freight strategy to improve delivery times, reduce fuel use, and increase efficiency.								

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Saskatchewan Congestion and Idling Reduction Program	Transportation	CO_2	Reduce emissions from congestion and idling	Voluntary Agreement	Adopted	2019	Saskatchewan	NE[h]	NE[h]
Brief Description	The program will utilize traffic data to identify congested areas and bottlenecks and to develop the program and projects to address congestion issues and help mitigate GHG emissions.								
Saskatchewan Trucking Partnership Program	Transportation	CO_2	Increase fuel efficiency of trucks	Voluntary agreement	Adopted	2019	Saskatchewan	NE[h]	NE[h]
Brief Description	The approach is to first baseline fuel savings already in place through existing agreements and then work to expand the program and quantify savings annually.								
Saskatchewan Short Line Rail Program	Transportation	CO_2	Increase use of short line rail to reduce transportation emissions	Voluntary Agreement	Adopted	2018	Saskatchewan	NE[h]	NE[h]
Brief Description	Support industry in expanding the size and usage of the short haul (short line) rail systems.								
Saskatchewan Government Vehicles Right Sizing and Best Practice Procurement Program	Transportation	CO_2	Increase fuel efficiency of government vehicles	Voluntary Agreement	Adopted	2009	Saskatchewan	NE[h]	NE[h]
Brief Description	Minimize the environmental impact of government vehicles by right-sizing the fleet. The initiative involves meeting regularly with Ministry clients to identify their needs for fleet size, utilization, and standardized vehicles based on service delivery. Since 2009, the Saskatchewan Government has reduced the size of the fleet by 2,500 vehicles, or almost 45%. The existing fleet is now approximately 3,200 vehicles. A right-sizing assessment is completed and reviewed as a part of all new vehicle and vehicle replacement requests to ensure the fleet is operating in the most efficient and effective capacity. The government's goal is to reduce CO_2 emissions from its vehicles by 20% from 2007 levels by 2020. The Government has made progress and is close to meeting the target with an 18% reduction of emissions from full maintenance passenger vehicles achieved as of March 31, 2017.								

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Manitoba Efficient Trucking Program	Transportation	CO_2,	Reduce emissions from freight transportation	Voluntary Agreement	Planned	2019	Manitoba	NE[h]	5.7
Brief Description	In June 2019, Manitoba and Canada launched a 3-year $11.8 million efficient trucking program for the installation of fuel saving technologies and retrofits to heavy-duty vehicles to reduce fuel consumption and greenhouse gas emissions, which includes $5.9 million in funding from the Low Carbon Economy Leadership Fund. The program is forecast to reduce global emissions by 60,000 tonnes by 2023.								
Manitoba biofuel standards	Transportation	CO_2	Reduce emissions from transportation	Regulatory	Planned	2020	Manitoba	NE[h]	NE[h]
Brief Description	In November 2019, Manitoba announced it would increase the minimum mandatory ethanol content in gasoline to 10% and the minimum mandatory biodiesel content in diesel fuel to 5% in 2020. These measures are estimated to reduce emissions by at least 475 kilotonnes by 2023.								
Manitoba government fleet reduction	Transportation	CO_2,	Reduce emissions from transportation	Voluntary Agreement	Implemented	2019	Manitoba	NE[h]	NE[h]
Brief Description	In October 2019, the Manitoba government committed to remove 400 vehicles from the government fleet as part of a fleet vehicle reorganization. Over the next five years, with a smaller fleet, it is estimated the province will save about 8.8 million litres of fuel and could reduce emissions by approximately 23,300 t.								
Ontario Transit Investments	Transportation	CO_2, CH_4, N_2O	Increasing options for transportation, safe and secure mobility, and lower GHG emissions	Economic	Implemented/Planed	Ongoing	Ontario	NE[h]	NE[h]
Brief Description	Through the GO Rail Expansion program the existing GO rail network will be transformed by providing two-way, all-day frequent service over core segments of the GO Transit rail network. The Province will look for opportunities for technology that could be used to electrify core segments of the GO Transit rail network, such as an overhead catenary system or hydrogen fuel cells. Ontario is also making the single largest capital investment in new subway builds and extensions in Ontario's history through the province's "New Subway Transit Plan for the Greater Toronto and Hamilton Area (GTHA)", which carries a total estimated capital construction cost of $28.5 billion for four priority projects. Ontario also provides financial support for municipal transit programs across the province through initiatives such as the Gas Tax program and provincial contributions to the federal Investing in Canada Infrastructure program, and investments in other important projects such as the Ottawa Light Rail Transit and Waterloo Rapid Transit projects.								

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Ontario Low-Carbon Solutions for the Heavy Duty Trucking Sector	Transportation	CO_2	Remove barriers to expanding compressed natural gas refueling for trucks	Regulatory	Planned	2019	Ontario	NE[h]	NE[h]
Brief Description	On April 3, 2019, Bill 66, *Restoring Ontario's Competitiveness Act (2018)* received Royal Assent. The bill contains amendments to the *Technical Standards and Safety Act, 200*0, that allows the Government and Consumer Services Minister to review and approve alternate rules created by the Technical Standards and Safety Authority. Alternate rules will be applied to the Operating Engineers regulation, under the Act, and are intended to reduce burden on business by adopting a risk-informed framework to determine operating engineer staffing requirements. The changes are the first steps toward implementing the government's commitment to remove barriers to expanding 24/7 compressed natural gas refueling stations for trucks along the 400-series highways.								
Ontario *Greener Gasoline Regulation (amendment to the Ethanol in Gasoline regulation)*	Transportation	CO_2	Reduce GHG emissions from transportation	Regulatory	Implemented	2020	Ontario	NE[h]	NE[h]
Brief Description	Currently, the required level of ethanol in gasoline is five percent by volume. In 2020, gasoline suppliers will be required to maintain an average of 10% renewable content (e.g. ethanol) in regular gasoline. The renewable content used for compliance will be required to meet an average lifecycle greenhouse gas (GHG) performance benchmark of 45% fewer GHG emissions than petroleum gasoline, assessed across the fuel's full well-to-wheels lifecycle from extraction or cultivation to processing, distribution and end-use combustion. This is determined in combination with the 10% average renewable content. Starting in 2023, fuel volumes sold in or distributed from Northern Ontario will be subject to the renewable content requirements introduced in 2020.								

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Québec Assistance Program to Improve Public Transit Services	Transportation	CO_2, CH_4	Reduce GHG emissions from the transportation sector	Economic	Implemented	2013	Québec	23	NE[h]
Brief Description	The program will impact GHG emissions associated with passenger transportation through supporting transit authorities to increase public transit services, operations, and capital projects. Investments are made in urban and rural services as well as interregional bus transport.								
Québec Transportation Electrification Initiatives*	Transportation	CO_2, CH_4, N_2O	Reduce GHG emissions in the transportation sector and accelerate the deployment of electric vehicles and associated infrastructure	Economic	Implemented	2012	Québec	89.5	NE[h]
Brief Description	Québec places significant emphasis on electric transportation, including light vehicles and electric public transportation, and promoting the development of the electric industrial sector. Targets for 2020 aim to: reach 100,000 electric vehicles and rechargeable hybrids; reduce the number of litres of fuel consumed annually in Québec by 66 million; reach 5,000 jobs in the electric vehicle sector and bring about investments of $500 million. The Drive Green program has two components: the Drive Electric program and the Connected at Work program. The Drive Electric program offers a rebate to individuals, businesses, not-for-profit organizations and municipalities in Québec who purchase or rent an eligible vehicle. The rebate varies from $4,000 to $8,000 for fully electric vehicles and rechargeable hybrids. All those who purchase or rent a fully electric vehicle or a plug-in hybrid electric vehicle can also ask for financial assistance to purchase and install a 240-volt charging station at their home. The Connected at Work program offers businesses, municipalities and organizations a reimbursement on the installation of charging stations at the workplace. The financial assistance offered for a charging station equals the lesser of the following amounts: 50% of the eligible expenses or $5,000. The maximum amount of financial assistance granted to an establishment is set at $2,000 per fiscal year. Hydro-Québec's Electric Circuit is the first public network of charging stations for electric vehicles in Canada, offering 240-volt and 400-volt charging stations. As of June 2019, the network had 1,947 charging stations in service, including 195 quick-charge stations.								

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Québec Eco Trucking Program*	Transportation	CO_2, CH_4, N_2O	Reduce the GHG emissions from the transportation sector	Economic	Implemented	2013	Québec	325	NE[h]
Brief Description	The Eco-trucking program aims to promote the use of equipment and technology to improve energy efficiency while reducing GHGs in the transportation of goods. This program offers financial support for eligible technology and the completion of projects to reduce GHG emissions.								
Québec Energy Efficiency Program for Marine, Air and Railway Transportation	Transportation	CO_2, CH_4, N_2O	Reduce GHG emissions in the transportation sector	Economic	Implemented	2013	Québec	135	NE[h]
Brief Description	This program aims to reduce or avoid GHG emissions by offering financial assistance to improve the energy efficiency of organizations and companies that use marine, air or railway transportation services, particularly through the use of more efficient transportation materials and equipment. The program consists of two components: Infrastructure and Equipment, and Studies and Pilot Projects. Businesses, municipal organizations and other legally constituted organizations with an establishment in Québec are eligible for the program.								
Québec Program Aiming to Reduce or Avoid GHG emissions through Intermodal Transportation*	Transportation	CO_2, CH_4, N_2O	Reduce GHG emissions in the transportation sector	Economic	Implemented	2013	Québec	250	NE[h]
Brief Description	The program aims to reduce or avoid GHG emissions generated by the transportation of goods or people through intermodal projects and by promoting marine and railway services. Businesses, municipal organizations and other legally incorporated organizations with an establishment in Québec are eligible for the program. The program has five components–projects with infrastructure expenses, projects with no infrastructure expenses, pilot projects, studies and the promotion of maritime or railway modes of transportation – and the financial contributions vary depending on the component. Assistance can vary from \$400 to \$750 per tonne of reduced or avoided GHG emissions for components 1 and 2. For component 3, a maximum of \$1 million can be granted per project, whereas for components 4 and 5, the maximum is \$50,000.								
Québec Support for the deployment of electric school buses	Transportation	CO_2, CH_4, N_2O	Reduce GHG emissions from the transportation sector	Economic	Implemented	2013	Québec	NE[h]	NE[h]
Brief Description	A one-time rebate of \$105,000 is granted for the purchase of a fully electric school bus. The rebate is issued to: (1) school bus providers on contract with school boards and private teaching establishments, and (2) school boards and accredited private teaching establishments.								

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Québec Zero Emission Vehicle Regulation*	Transportation	CO_2, CH_4, N_2O	Reduce GHG emissions from the transportation sector and accelerate the deployment of electric vehicles and related infrastructure	Regulatory	Implemented	2018	Québec	NE[h]	NE[h]
Brief Description	Starting with 2018 models, automakers are required to meet a credit target set by the government. Credits may be accumulated by the sale of zero emission vehicles (ZEV), or by obtaining credits from other auto manufacturers. Automakers that sell or lease a yearly average of more than 4,500 new vehicles (all light models combined) are subjected to the ZEV standard. The ZEV standard is expected to contribute to the acquisition of approximately 64,000 electric vehicles by 2020. This regulation is an enabling measure that will not directly reduce emissions but will contribute to unlocking larger emissions reductions.								
Québec Regulation on the Activation of Speed Limiters with a Maximum of 105 km/h	Transportation	CO_2, CH_4, N_2O	Reduce GHG emissions of heavy vehicles	Regulatory	Implemented	2009	Québec	NE[h]	NE[h]
Brief Description	Since January 1, 2009, serial speed limiters have been activated and regulated in such a way as to prevent vehicles from exceeding 105 km/h. This measure is for heavy vehicle operators from anywhere whose trucks use the Québec roadway network.								
Québec Eco-driving for heavy vehicles	Transportation	CO_2	Reduce GHG emissions in the transportation sector	Education	Planned	2019	Québec	19.8	NE[h]
Brief Description	The Program offers financial assistance for eco-driving training or awareness activities for drivers of light or heavy vehicles. Financial assistance is provided to the applicant in the form of a purchase rebate applied immediately upon invoicing of an activity by an approved organization. The Program is intended to encourage the adoption of eco-driving by equipping drivers of on-road vehicles to: • understand the factors that explain the fuel consumption of a road vehicle; • acquire new knowledge that will enable them to adopt the most appropriate behaviours to reduce energy consumption; • develop more energy-efficient and safe driving								

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New Brunswick Electric Vehicles and Infrastructure	Transportation	CO_2, N_2O	To have 20,000 electric vehicles registered by 2030	Voluntary Agreement	Adopted	2016	New Brunswick	NE[h]	40
Brief Description	New Brunswick's electric vehicle recharge network now includes: 26 Level 3 fast-charging stations located along all major corridors across the province, linking the network with neighbouring provinces and state, and 95 regular charging stations, situated in most communities throughout the province. Robust charging infrastructure is a necessary first step in supporting electric vehicle procurement.								
Prince Edward Island Sustainable Transportation Action Plan	Transportation	CO_2	Reduce emissions from transportation sector through efficiency, fuel-switching and alternative transportation modes	Voluntary Agreement	Planned	2024	Prince Edward Island	NE[b]	NE[h]
Brief Description	A Sustainable Transportation Action Plan was released in November 2019. The action plan contains 27 actions in four key areas: public transit, vehicles, active transportation, and community design. A variety of government departments, agencies, and organizations will implement the plan through programs, services and policies over the course of 5 years.								
Prince Edward Island Greening Government	Transportation	CO_2	Reduce emissions from government fleet and buildings	Voluntary Agreement	Planned	2023	Prince Edward Island	NE[b]	6
Brief Description	As part of the Climate Change Action Plan, the province plans to implement a greening government program, including the development of a GHG emissions inventory for government, energy efficiency upgrades to provincial buildings, improved fuel efficiency of its vehicle fleet, and a commitment to green procurement. Fuel-switching (light fuel oil to biomass) has begun in several government buildings and three electric vehicles and two hybrid vehicles were added to the government fleet. Additional fuel-switching and energy efficiency measures are planned for the following years, and additional electric and hybrid vehicles will be added to the government fleet.								

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Prince Edward Island Electric Vehicle Charging Network	Transportation	CO_2	Encourage adoption of electric vehicles	Voluntary Agreement	Planned	2019/2020	Prince Edward Island	NE[h]	NE[h]
Brief Description	Federal and provincial funding support was secured to build PEI's first level 3 electric vehicle fast charger network. Six public locations were chosen: O'Leary, Summerside, Borden-Carleton, Charlottetown, Wood Islands, and Souris. Installation of the charging stations will be completed in 2019/2020.								
Newfoundland and Labrador freight transportation measures	Transportation	CO_2, CH_4, N_2O	Improve on-road freight transportation efficiency	Fiscal	Implemented	2019	Newfoundland and Labrador	NE[h]	NE[h]
Brief Description	To provide incentives for freight transportation companies to install technologies such as aerodynamic devices and alternative power sources (e.g., auxiliary batteries).								
Newfoundland electric vehicle charging network	Transportation	CO_2, CH_4, N_2O	Encourage adoption of electric vehicles	Fiscal	Planned	2019/2020	Newfoundland and Labrador	NE[h]	NE[h]
Brief Description	To introduce level-3 charging stations to the province's existing network of Level-2 charging stations. 14 level 3 fast-charging stations will be located on the Trans Canada Highway. Level-3 stations are necessary to allow for increased penetration of EVs in the province.								
OIL AND GAS									
Oil and Gas Clean Technology Program*	Oil and Gas	CO_2, CH_4, N_2O	Reduce GHG emissions	Economic	Implemented	2016	Natural Resources Canada	NE[c]	NE[c]
Brief Description	The program provided $50 million over two years to support 8 innovative, industry-led projects to develop and demonstrate cost-effective technologies that reduce GHG emissions from the oil and gas sector. In addition to the direct emissions reductions from demonstration projects, the program will contribute additional indirect emissions reductions of approximately 1,500-2,500 Kt in 2030. The program is expected to deliver long-term emissions reductions through supporting the development and demonstrations of clean energy technologies which reduces technical risk and helps accelerate market adoption of the funded technologies. This program is part of the Energy Innovation Program; mitigation estimates are included under that program.								
Regulations to Address Methane in the Oil and Gas Sector*	Oil and Gas	CH_4	Reduce emissions from methane in the oil and gas sectors in Canada	Regulatory	Implemented	2020	Environment and Climate Change Canada	4,000	20,000
Brief Description	As part of the Pan-Canadian Framework, the Government of Canada reaffirmed its commitment to reduce methane emissions from the oil and gas sector by 40 to 45% from 2012 levels by 2025, building on provincial actions and targets. To implement this commitment, Canada introduced federal regulations in April 2018 to reduce venting and fugitive methane emissions from existing and new oil and gas sources. The regulations will enter into force in January 2020.								

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British Columbia GHG Industrial Reporting and Control Act*	Oil and Gas	CH_4, CO_2	Reduce industrial GHG emissions growth	Fiscal	Implemented	2013	British Columbia	NE[h]	NE[h]
Brief Description	British Columbia implemented a liquefied natural gas emissions intensity benchmark under the *Greenhouse Gas Industrial Reporting and Control Act*. Liquefied natural gas (LNG) facilities are required to meet the emissions intensity benchmark of 0.16 tonnes CO_2 eq/t LNG either through adopting more efficient technologies, using clean energy, investing in offsets, or purchasing "funded units" at CA$25/tonne that contribute to clean technologies.								
British Columbia Clean Growth Infrastructure Royalty Program	Oil and Gas	CO_2, CH_4	Reduce oil and gas GHG emissions	Economic	Implemented	2016	British Columbia	NE[h]	NE[h]
Brief Description	The Program encourages new capital investment in oil and natural gas infrastructure. The program creates and sustains good paying jobs for British Columbians and stimulates new royalty revenue while helping to achieve the Government's GHG reduction targets and methane reduction targets. Oil and gas companies can apply for a deduction to the royalties they would otherwise pay to the Province under a competitive Request for Applications process. For projects that are approved, a company must fully fund and complete an approved project before it can apply to recover up to 50% of the project's cost in the form of a royalty deduction.								
British Columbia Electrification of the Natural Gas Sector*	Oil and Gas	CH_4, CO_2, N_2O	Reduce oil and gas GHG emissions	Economic	Implemented	2016	British Columbia	NE[h]	3,470
Brief Description	BC amended the *GHG Reduction (Clean Energy) Regulation* to support the development of additional transmission infrastructure in northeast BC to provide clean electricity to meet increasing demand from the upstream natural gas sector. The regulation enables the electricity utility BC Hydro to provide incentives for electrification to bridge the cost difference between using natural gas and electricity in upstream oil and gas infrastructure.								
British Columbia Expanded Incentives for Efficient Gas Equipment*	Oil and Gas	CO_2, N_2O	Reduce oil and gas GHG emissions	Economic	Implemented	2017	British Columbia	80	80
Brief Description	The incentives will allow utilities to expand their incentives by at least 100%, to encourage further adoption of technologies that reduce the emissions from gas fired equipment.								

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British Columbia Regulatory Framework for Carbon Capture and Storage*	Oil and Gas	CO_2	Reduce oil and gas GHG emissions	Regulatory	Planned	2020	British Columbia	NE[h]	590
Brief Description	The framework will allow carbon capture and storage projects at natural gas extraction and processing facilities to proceed upon the completion of regulatory policy work. CleanBC reaffirms the commitment to establish a regulatory framework for safe and effective underground CO_2 storage and direct air capture.								
British Columbia Methane Reduction Policy	Oil and Gas	CH_4	Reduce oil and gas GHG emissions	Fiscal	Planned	2017	British Columbia	NE[c]	NA[c]
Brief Description	This policy was introduced through an amendment to British Columbia's *Drilling and Production Regulation*. It will come into effect on January 1, 2020, and reduce methane emissions from upstream oil and gas operations to meet or exceed federal and provincial methane emission reduction targets. The policy targets extraction and processing emissions (referred to as upstream in the natural gas sector), including: legacy phase, targeting a 45% reduction by 2025 in fugitive and vented emissions in infrastructure built before January 1, 2015; transition phase, including incentives through a new offset protocol to encourage further innovative projects, a Clean Infrastructure Royalty Credit Program for all applications built between 2015 and 2018, and a Clean Growth Infrastructure Royalty Program for applications in 2019 and beyond; and future phase, implementing standards to guide developments of projects after the transition phase, where leak detection and repair will be mandatory and protocols developed to align with other jurisdictions. Estimate of mitigation impact in 2030 is included under federal Regulations to Address Methane in the Oil and Gas Sector.								
Alberta Oil Sands Emissions Limit Act*	Oil and Gas	CO_2	Cap emissions from the oil sands sector to 100 Mt	Regulatory	Adopted	2018	Alberta	NE[h]	NE[h]
Brief Description	The *Oil Sands Emission Limit Act* creates the legal framework for setting a legislated maximum emissions limit of 100Mt in any year for oil sands facilities with provisions for co-generation and new upgrading capacity.								
Alberta Directive 060: Upstream Petroleum Industry Flaring, Incinerating and Venting	Oil and Gas	CH_4, CO_2	To reduce flaring and venting in the oil and gas sector	Regulatory	Implemented	1999	Alberta	4,000	NE[h]
Brief Description	Requirements have been developed in consultation with the Clean Air Strategic Alliance to eliminate or reduce the potential and observed impacts of these activities and to ensure that public safety concerns and environmental impacts are addressed before beginning to flare, incinerate, or vent. Directive 060 requirements are also aligned to ensure compliance with Alberta Environment and Sustainable Resource Development's Alberta Ambient Air Quality Objectives and Guidelines.								

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Alberta reduction of methane emissions*	Oil and Gas	CH_4	Alberta will reduce methane emissions from upstream oil and gas operations by 45% from 2014 level by 2025	Regulatory	Implemented	2020	Alberta	NE[c]	NE[c]
Brief Description	Alberta will reduce upstream oil and gas methane emissions by 45% by 2025. This will be achieved through the implementation of methane emission reduction requirements contained in Alberta Energy Regulator Directive 060: Upstream Petroleum Industry Flaring, Incinerating and Venting" and Directive 017: Measurement Requirements for Oil and Gas Operations". These Directive amendments were published in December 2018 along with the Government of Alberta's *Methane Emission Reduction Regulation*. Estimates of mitigation impact are included under Alberta's Large Emitter Greenhouse Gas Regulations.								
Saskatchewan Methane Action Plan	Oil and Gas	CH_4	Reduce emissions from venting and flaring	Regulatory	Implemented	2019	Saskatchewan	NE[e]	NE[e]
Brief Description	Saskatchewan released the Methane Action Plan in January 2019. The plan commits to introducing regulation that will reduce methane emissions in the upstream oil and gas sector by between 40% and 45% by 2025. It also commits to introducing a suite of new programs and policies that will increase and accelerate opportunities to capture and commercialize methane.								
Saskatchewan Oil and Gas Emissions Management Regulations	Oil and Gas	CH_4	Reduce emissions from venting and flaring	Regulatory	Implemented	2019	Saskatchewan	NE[h]	4,500
Brief Description	Regulations under the Methane Action Plan to reduce greenhouse gas emissions from oil and gas wells and facilities using a results-based system that: • Provides each oil and gas operator the ability to efficiently prioritize emission reduction investments; • Supports adoption of innovative emissions reduction technologies; • Firmly establishes provincial regulatory oversight of emissions from the oil and gas industry; and • Includes a strategy to support the increased use of methane produced in association with oil for heating and electricity production, including the establishment of usage requirements for this source of natural gas.								

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Saskatchewan *Regulation Respecting the Management and Reduction of Greenhouse Gases (Standards and Compliance)**	Oil and gas	CH_4, CO_2, HFCs, N_2O, SF_6, PFCs	Reduce industrial emissions	Regulatory	Implemented	2019	Saskatchewan	148.5	891.1
Brief Description	Saskatchewan has developed sector-specific output-based performance standards on facilities emitting more than 25,000 tonnes of CO_2 eq per year. The standards apply to more than 60 Saskatchewan industrial facilities that cumulatively generate 11.6% (approximately 9.0 million tonnes) of total provincial emissions and are expected to reduce that portion by a total of 10% by 2030. Obligate facilities that annually emit more than the regulated performance standard are able to use a suite of flexible compliance options to meet their obligations in the way best suited to their business models, including: • Payments into a provincial technology fund; • Purchase of best performance credits from other large industrial emitters who have emitted below their performance standard; and • Use of offset credits purchased through a provincial GHG offset system								
Newfoundland and Labrador methane regulations	Oil and Gas	CH_4	Reduce emissions from venting and flaring	Regulatory	Planned	2020	Newfoundland and Labrador	NE[e]	NE[e]
Brief Description	Newfoundland and Labrador is working with the federal government to adopt methane emissions regulations that recognize the unique management structure of the offshore petroleum industries in that province. Newfoundland and Labrador will introduce regulations that will allow the Canada-Newfoundland and Labrador Offshore Petroleum Board to regulate methane emissions in a manner similar to *Canadian Environmental Protection Act* (1999) regulations.								
BUILDINGS									
Green Construction through Wood Program**	Buildings	CO_2	Reduce GHG emissions in the buildings sector	Economic	Implemented	2018	Natural Resources Canada	NE[a]	500
Brief Description	The program launched in October 2017 and supports projects and activities that increase the use of wood as a greener building material in infrastructure projects. Calls for Expressions of Interest for tall wood buildings, low-rise non-residential buildings, and timber bridges have all closed. The program received 57 applications over the three calls and is targeting the delivery of 15-20 demonstration projects under the program. The majority of agreements have been signed and projects are underway.								

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Federal Energy Efficient Buildings Initiatives **	Buildings	CO_2, CH_4, N_2O	Accelerate and enhance the promotion of energy efficiency in the buildings sector	Information	Planned	2018	Natural Resources Canada	NE[h]	11,200
Brief Description	A number of energy efficiency measures have been outlined under Green Infrastructure, as part of the Investing in Canada Plan. These actions include: the development of net-zero energy ready model building codes; the development of a new model code for building alterations by 2022; and joint efforts between the federal, provincial and territorial governments to require labelling of building energy use.								
British Columbia Promoting Use of Low Carbon and Renewable Materials in Infrastructure	Buildings	CO_2	Reduce the embedded carbon in infrastructure	Voluntary Agreement	Planned	TBD	British Columbia	NE[h]	NE[h]
Brief Description	BC is developing policies to increase the use of low carbon and renewable materials in all public sector infrastructure.								
British Columbia Technology and Retrofit Incentive Programs*	Buildings	CO_2	Reduce GHG emissions in buildings	Economic	Implemented	2015	British Columbia	130	80
Brief Description	A variety of programs provide incentives for energy efficiency measures. CleanBC Better Homes and Better Buildings includes incentives for renovating or building homes and other buildings, including rebates for energy efficiency upgrades such as new windows, rebates to convert from less efficient oil heating systems to all-electric air source heat pumps, incentives to do energy-saving studies and upgrades, and energy coaching services for homes and businesses. The ISO 50001 incentive is run by the BC Government and the federal government and offers up to $80,000 of cost-shared assistance to BC industrial companies to implement energy management system projects that help facilities to comply with the standard, which enables companies to systematically reduce energy consumption and emissions.								
British Columbia Climate Action Charter	Buildings	CO_2	Reduce GHG emissions in buildings and transportation	Economic	Implemented	2008	British Columbia	NE[h]	NE[h]
Brief Description	The Charter is an agreement between provincial and municipal governments to work towards carbon neutral operations and complete, compact, low carbon communities.								

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British Columbia Building Green Code*	Buildings	CO_2	Improve energy efficiency in new houses and buildings	Regulatory	Implemented	2008	British Columbia	500	500
Brief Description	Since 2008, British Columbia has been working to improve energy efficiency in the building sector, including for large residential, industrial and commercial buildings, houses and small buildings, as well as in public sector buildings, including a LEED Gold requirement and research on low carbon building material options. In 2017, BC introduced a Step Code: Increased Energy Efficiency Requirements in the BC Building Code, Energy Step Code: Energy Efficiency, and a Net-Zero Energy Ready Building Design Incentive. CleanBC, released in 2018, seeks to improve the Building Code further.								
Saskatchewan Energy Efficiency Standards for Buildings*	Buildings	CO_2	Reduce emissions associated with buildings	Regulatory	Adopted	2019	Saskatchewan	NE[h]	NE[h]
Brief Description	Adopted the 2015 National Building Code effective January 1, 2018, with provisions that improve energy efficiency standards for houses and small buildings taking effect January 1, 2019. Will facilitate provisions in the National Building Code 2015 that provide for increased use of wood in building construction in order to extend carbon storage. New government buildings are required to exceed the energy performance requirements of the 2015 National Energy Code for Buildings by 10%. In addition, all new government builds and major renovations will be designed to meet or exceed LEED Silver certification standards.								
Efficiency Manitoba Act* and Energy Efficiency Programing	Buildings	CO_2	Reduce energy use and improve energy efficiency	Voluntary Agreement	Implemented	2001	Manitoba Hydro and Efficiency Manitoba	NE[h]	NE[h]
Brief Description	Manitoba Hydro delivers demand side management programs to its residential, commercial and industrial customers to assist them to reduce their use of electricity and natural gas. Energy efficiency programming will be transitioned to Efficiency Manitoba, as per the *Efficiency Manitoba Act*, in in 2020. Efficiency Manitoba is a new standalone Crown corporation with the sole purpose of administering and delivering energy savings cost-effectively to consumers. As per the act, Efficiency Manitoba needs to meet legislated savings targets of 22.5% of domestic electricity demand (an average of 1.5% annually of domestic electricity consumption) and 11.25% of domestic natural gas demand (an average of 0.75% annually of natural gas consumption) over a 15-year period.								

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Ontario Building Code	Buildings	CO_2, CH_4, N_2O	Establish standards and promote improvements in energy efficiency	Regulatory	Planned	2018	Ontario	NE[h]	NE[h]
Brief Description	Ontario intends to review its building code and support the adoption of cost effective energy efficiency measures that can lower the cost of electricity and natural gas needed to operate buildings. Ontario is also proposing to modernize the building code to better equip homes and buildings to be better able to withstand extreme weather events. This may include affordable adaptation measures such as requiring backwater valves in new homes that are at risk of backflow, and would reduce the impacts of basement flooding.								
Ontario Natural Gas Demand Side Management Programs*	Buildings	CO_2	Reduce natural gas consumption in the residential, commercial and industrial sectors	Regulatory	Implemented	2003, 2015	Ontario	5300	NE[h]
Brief Description	Ontario's main natural gas utility, Enbridge Gas, has been delivering natural gas energy efficiency programs to its industrial, commercial, institutional and residential customers for over 20 years under the Demand Side Management (DSM) Framework, which is overseen by the Ontario Energy Board (OEB). Demand Side Management Programs have been implemented from 2003 to 2014, and the current plan which in operation from 2015 to 2020. The estimated associated GHG mitigation impact of 5.3 Mt accounts for: GHG savings from verified historic programs (2003–2017) that are expected to persist in 2020; and planned GHG savings from in-market programs (2018–2020) under the current 2015–2020 Demand Side Management Framework, that are expected to persist in 2020. As the 2015-2020 DSM Framework will expire on December 31, 2020, the OEB has initiated a consultation to consider the next generation DSM Framework, with a view to ensuring that the OEB's approach remains current, responsive to energy efficiency and conservation market developments and consistent with broader government policy.								
Québec Chauffez Vert Program	Buildings	CO_2	Reduce GHG emissions in the building sector (private homes)	Economic	Implemented	2016	Québec	329	NE[h]
Brief Description	Chauffez Vert is a program that encourages energy-efficient residential renovations in order to reduce the energy consumption and greenhouse gas emissions of homes in Québec, while improving the comfort of occupants. Financial assistance is granted for the conversion of a primary heating system that uses oil, propane or any other fossil fuel except natural gas, to a primary heating system powered by geothermal, hydro, wind or solar energy.								

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Québec Construction Code	Buildings	CO_2, CH_4, N_2O	Reduce GHG emissions and energy consumption in the building sector	Regulatory	Planned	2020 (phase 2)	Québec	NE[h]	73.5
Brief Description	The Construction Code was first amended in 2012 in order to introduce new energy efficiency standards for residential buildings (3 stories maximum). A second amendment phase is currently underway. These amendments will touch the energy efficiency requirements for commercial, institutional, industrial and tall residential buildings. They will improve the energy performance of new buildings by 20% to 25% compared to the previous regulation. A third phase is planned to further increase the energy efficiency requirements for the small residential sector and will occur once the amendments of phase two are implemented.								
Québec Éconologis Program	Buildings	CO_2	Reduce GHG emissions in the building sector	Economic	Implemented	2013	Québec	NE[h]	NE[h]
Brief Description	Éconologis is an energy efficiency program for low-income households. It allows these households to take advantage of free individualized advice and even to have electronic thermostats installed free of charge.								
Québec Novoclimat Program	Buildings	CO_2, CH_4, N_2O	Reduce GHG emissions and energy consumption in the building sector	Economic	Implemented	2013	Québec	NE[h]	NE[h]
Brief Description	The Novoclimat 2.0 Program–House component (implemented in 2013) encourages the construction of new high energy performance houses according to specific construction requirements. The program provides up to $4,000 in financial assistance to first-time owners of a Novoclimat 2.0 approved house. The Novoclimat 2.0 program also applies to small multiple-unit buildings such as a duplex, triplex and quadruplex as well as multiple-unit buildings of three or fewer stories and 600 m^2 or less. The first Novoclimat program (implemented in 1999) still applies to properties of more than 600 m^2 and up to 10 stories for which the main energy source is electricity, natural gas or residual forest biomass.								
Quebec - Making institutions eco-responsible	Buildings	CO_2	Reduce GHG emissions in the building sector (institutional)	Economic	Implemented	2016	Québec	22.8	NE[h]
Brief Description	The program aims to provide financial assistance for projects that implement one or more targeted means of saving fossil fuel consumption with a prospect of reducing or avoiding overall GHG emissions. An example of a project: Work to replace oil or natural gas-fired boilers with systems that run on renewable energy (geothermal, aerothermal, electric boilers, etc.)								

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Québec Residual Forest Biomass Program	Buildings	CO_2	Reduce GHG emissions from heating buildings	Economic	Implemented	2013	Québec	79.4	NE[h]
Brief Description	This program aims to reduce GHG emissions and the consumption of fossil fuels by funding specific energy conversion projects to switch from fossil fuels to residual forest biomass.								
New Brunswick Energy Efficiency Program	Buildings	CO_2, N_2O	Improve the energy efficiency of buildings and operations for all fuels	Voluntary Agreement	Implemented	2005	New Brunswick	60	260
Brief Description	Through amendments to the *Electricity Act*, Efficiency New Brunswick was moved into NB Power and NB Power was provided the mandate to: promote energy efficiency measures in the residential, community and business sectors; develop and deliver programs and initiatives in relation to energy efficiency; promote the development of an energy efficiency service industry; act as a central resource for the promotion of energy efficiency; and raise awareness of how energy efficiency measures can lead to a more reliable energy supply for New Brunswick.								
New Brunswick Provincial Energy Retrofit and Renewable Energy Program	Buildings	CO_2, N_2O	Improve the energy efficiency of provincially operated buildings	Fiscal	Implemented	2016	New Brunswick	41	162
Brief Description	These measures reduce GHG emissions through building systems re-commissioning, lighting upgrades, converting to lower emissions fuel sources and implementation of renewable energy systems.								
Nova Scotia Energy Efficiency Measures for Non-Electrically Heated Homes	Buildings	CO_2, CH_4, N_2O	Encourage energy efficiency	Economic	Implemented	2011	Nova Scotia	NE[h]	NE[h]
Brief Description	Homeowners on a low income can qualify for no-charge home efficiency upgrades through Efficiency Nova Scotia's Low Income Homeowner Service. Since 45% of the heat loss in a typical home occurs through the walls, floors and roof, a primary focus is on insulation and draft proofing. For those who qualify for the program, a certified energy advisor will conduct a home-energy assessment and energy efficient upgrades are provided at no cost to the homeowner. Program participants who heat with non-electrical heat sources save, on average, $900 per year.								

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Prince Edward Island Biomass	Buildings	CO_2	Reduce energy use and GHG emissions from the building sector	Economic	Planned	2022	Prince Edward Island	NE[b]	4
Brief Description	The province solicited proposals for the installation of biomass heating systems in public buildings. Systems were selected for four facilities across PEI: West Royalty Elementary, Westwood Primary, ME Callaghan Intermediate, and a combined plant for Kensington Intermediate Senior High School and Queen Elizabeth Elementary. These four facilities will be installed by the end of 2019 and operational for this winter. This project is funded in part by the Government of Canada's Low Carbon Economy Leadership Fund. Six additional biomass systems are expected to be installed in public buildings in 2020.								
Prince Edward Island *Building Code Act**	Buildings	CO_2	Reduce energy use and GHG emissions from the building sector	Regulatory	Adopted	2020	Prince Edward Island	NE[h]	10
Brief Description	In 2017, Prince Edward Island passed the *Building Code Act*. This legislation will adopt both the National Building Code of Canada and the National Energy Code of Canada for Buildings. Draft regulations will undergo public consultation in 2019. The Act and regulations will come into effect in January 2020, with the exception of single and two-unit residential structures, which are proposed to be delayed by one additional year.								
Prince Edward Island Energy Efficiency and Fuel Switching Rebate Programs (efficiencyPEI)*	Buildings	CO_2	Support residential and commercial energy efficiency	Fiscal	Implemented	2008/2009 2017/18 (LCEF components)	Prince Edward Island	NE[h]	145
Brief Description	Prince Edward Island delivers a suite of programs to enhance efficiency in the residential and commercial building sector including Energy Efficiency Equipment and Appliance Rebates, Home Insulation Rebates, Instant Rebate Program, New Home Construction Incentive, Energy Efficiency Loan Program, Home Comfort and Winter Warming Programs (Low-income weatherization Building Envelope Upgrades), Energy Audit Programs, and Business Energy Rebates. Many of these programs have been expanded with support from the Low Carbon Economy Leadership Fund.								
Newfoundland and Labrador energy efficiency support	Buildings	CO_2, CH_4, N_2O	Support residential, commercial and public sector energy efficiency	Fiscal	Implemented	2019	Newfoundland and Labrador	NE[h]	10.6
Brief Description	Newfoundland and Labrador, including through the electrical utilities, delivers a range of grant and low interest loans programs to enhance efficiency in the residential, commercial and public building sectors including for heat pump initiatives. Many of these programs are supported by the Low Carbon Economy Leadership Fund. Given that electricity will be largely emissions-free after 2019, GHG reductions will accrue from fuel-oil heated buildings and in off-grid communities.								

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Northwest Territories Arctic Energy Alliance Rebate Programs	Buildings	CO_2	Support energy and water efficient technologies	Fiscal	Implemented	2007	Northwest Territories	0.5	NE[h]
Brief Description	The Northwest Territories has several publicly available building efficiency programs including: the Energy Efficiency Incentive Program (2007) that provides rebates for energy efficient appliances, residential retrofits, and new homes; the Alternative Technologies Program (2007) to support Indigenous and community governments, non-profit organizations, commercial businesses, and residents to convert to renewable and clean energies; and the Commercial Energy Conservation and Efficiency Program (2011) that enables eligible small businesses to receive free energy audits and rebates on the cost of retrofit expenses.								
Northwest Territories Arctic Energy Alliance Enhanced Programs and Services	Buildings	CO_2	Enhanced support for energy efficient initiatives	Fiscal	Implemented	2019	Northwest Territories	2	7.3
Brief Description	The Northwest Territories, with support from Environment and Climate Change Canada, has provided enhanced funding opportunities for some of the existing programs and services offered through Arctic Energy Alliance in addition to new programs such as; Low Income energy Assistance; Deep Home Energy Retrofits; Energy Efficiency Rebates for NGOs; Electric Heat Incentives; Wood Stove Programs; Community Energy Planning Implementation.								
Yukon Commercial Energy Incentive Program	Buildings	CH_4, CO_2, N_2O	Reduce diesel consumption for electricity and heat generation	Economic	Implemented	2015	Yukon	<1	NE[h]
Brief Description	The Government of Yukon's Commercial Energy Incentive Program aims to improve energy use in multi-family dwellings, commercial buildings and institutional buildings, as well as provide incentives for installing renewable energy systems. From May 1, 2015 to July 2019, the Commercial Energy incentive assisted with 73 retrofits, mostly for LED lighting system upgrades. These retrofits saved enough energy to power approximately 622 non-electrically-heated homes for one year and prevented 672 tonnes of greenhouse gas emissions from being generated.								
Yukon Residential Energy Incentive Program	Buildings	CO_2, CH_4, N_2O	Reduce diesel consumption for electricity and heat generation	Economic	Implemented	2015	Yukon	NE[h]	NE[h]
Brief Description	The Residential Energy incentive is for energy efficiency improvements to existing residences and for the construction of new super-insulated homes. From its start in 2015 to July 2019 the new homes rebate had an immediate and significant impact on the local construction industry, with approximately 67% of all the new homes constructed in Whitehorse built to a super-insulated standard. This program, along with Yukon's appliance rebate program has prevented over 46,000 tonnes of greenhouse gas emissions over the lifetime of the programs.								

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Nunavut Energy Management Program	Buildings	CO_2	Reduction of fossil fuel consumption	Voluntary Agreement	Implemented	2007	Nunavut	2.14	23.78
Brief Description	Initiated in 2007, the Nunavut Energy Management Program is a Government of Nunavut program led by the Department of Community and Government Services. The objectives are: • To reduce by 20% water, fuel and electricity consumption by retrofitting existing Government of Nunavut owned facilities territory wide; • To reduce GHG emissions by substituting diesel generated energy with renewables where feasible; • To explore new energy efficient building technologies.								
Nunavut Housing Corporation's Accelerated Modernization and Improvement Project	Buildings	CO_2	Reduction of fossil fuel consumption	Economic	Implemented	2018	Nunavut	2.04	20.43
Brief Description	The Nunavut Housing Corporation's Accelerated Modernization and Improvement Project received funding from the Government of Canada's Low Carbon Economy Fund in fall 2018 to oversee energy efficiency upgrades and retrofits to public housing units. Housing retrofits will include window and door replacements (Target 1) as well as hot water heater replacement (Target 2) and furnace/boiler replacements (Target 3). To kick-off this project, a master list of units which could benefit from upgrades was created out of 9/25 communities in Nunavut. These communities are Kugluktuk, Taloyoak, Baker Lake, Coral Harbour, Rankin Inlet, Sanikiluaq, Hall Beach, Igloolik, Iqaluit. From this list, specific units for 2019 have been selected in Iqaluit, Coral Harbour and Rankin Inlet. Contracts have been issued and work is expected to begin fall 2019 upon arrival of the sealift to the community.								
HEAVY INDUSTRY									
Energy Efficiency in Industry*	Heavy Industry	CO_2	Improve industrial energy efficiency in Canada	Fiscal, Voluntary Agreement, Information, Education	Implemented	2016	Natural Resources Canada	1,100	6,700
Brief Description	This program accelerates the adoption of recognized energy management systems, such as ENERGY STAR for Industry, ISO 50001 and Superior Energy Performance to improve industrial energy efficiency. ENERGY STAR for Industry Certification launched at the Energy and Mines Ministers' Conference on August 15, 2017. The ISO 50001:2018 standard, Energy management system–Requirements with guidance for use, was published in August 2018.								

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British Columbia Cement Low Carbon Fuel Program*	Heavy Industry	CO_2, CH_4, N_2O	Reduce industrial GHG emissions	Economic	Implemented	2016	British Columbia	NE[h]	NE[h]
Brief Description	Over the five year life of the program, British Columbia will offer up to $27 million in conditional incentives to encourage cement producers to use a higher percentage of renewables in their fuel mix, to secure long term renewable fuel supply contracts, and to meet or beat new emissions intensity benchmarks.								
Ontario Regulatory Changes for Reducing Coal Use in Energy-Intensive Industries	Heavy Industry	CO_2	Reduce GHG emissions, and coal and petroleum coke use	Regulatory	Implemented	2015	Ontario	NE[h]	NE[h]
Brief Description	Regulatory changes have been developed for major-emitting industrial sectors (including cement, lime and iron and steel manufacturers) that would help facilities use alternative, less carbon intensive fuels (such as biomass and waste materials) in place of coal and petroleum coke, and stay competitive with other jurisdictions that similarly allow the use of alternative fuel.								
Ontario Greenhouse Gas Emissions Performance Standards Regulation	Heavy Industry	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	Reduce greenhouse gas emissions from large industrial emitters	Regulatory	Adopted but not Implemented	TBD	Ontario	NE[h]	NE[h]
Brief Description	On July 4, 2019 the Ministry of the Environment, Conservation and Parks filed the *Greenhouse Gas Emissions Performance Standards (EPS)* regulation (O. Reg. 241/19) under the *Environmental Protection Act*. Regulating large emitters through the EPS program is a key part of the government's proposed made-in-Ontario environment plan to reduce GHG emissions and help Ontario achieve its 2030 target. Ontario's EPS is a regulatory approach that establishes GHG emissions performance standards that facilities are required to meet or use compliance units for GHG emissions in excess of the standard. The purpose of the EPS regulation is to reduce GHGs in the industrial sector and to provide flexibility for Ontario circumstances as an alternative to the federal OBPS portion of the federal *Greenhouse Gas Pollution Pricing Act.* If implemented, the EPS program is estimated to cover approximately 24% of provincial emissions and incent industries to reduce emissions by requiring compliance with total annual emissions limits determined from emission performance standards. In general, total annual emissions limits would decline by 2% per year for industries that are highly emissions intensive and/or trade exposed and by 5% per year for other industries. Only registration provisions of the EPS apply at this point in time. Compliance obligations would apply for the first time in the year the federal government removes Ontario from Part 2 of Schedule 1 of the *Greenhouse Gas Pollution Pricing Act*, if the federal government makes that decision.								
Newfoundland and Labrador Climate Change Challenge Fund*	Heavy Industry	CO_2, CH_4, N_2O	Reduce industrial GHG emissions	Fiscal	Implemented	2019	Newfoundland and Labrador	55	57
Brief Description	Newfoundland and Labrador is delivering a Climate Change Challenge Fund which can help industry enhance efficiency (other sectors, such as the residential, commercial and public building sectors are also eligible for assistance). This program is supported by the Low Carbon Economy Leadership Fund. Given that electricity will be largely emissions-free after 2019, GHG reductions will accrue from fossil fuel sources.								

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WASTE AND OTHER									
British Columbia Landfill Gas Management Regulation*	Waste and Other	CH_4	Increase methane capture rate at landfills	Regulatory	Implemented	2009	British Columbia	NE[h]	700
Brief Description	Under the regulation, regulated landfill sites (landfills that have over 100,000 tonnes of waste in place or receive more than 10,000 tonnes of municipal solid waste in any year after 2008) are required to conduct landfill gas assessments. If the assessment conducted in accordance with the regulation estimates a landfill will generate more than 1000 tonnes of methane in a calendar year, then they must install and operate a landfill gas collection and destruction system. The initial series of landfill gas assessments took place in 2011 with the requirement of a performance standard of 75% capture being in place by 2016. A new series of landfill gas assessments took place in 2016 with the same requirement being required for 2021. Reduction estimates are based on modelling of likely impact of the regulatory approach, allowing for variances in the performance of the technologic solutions applied to meet the standard. CleanBC commits the province to helping communities achieve 95% organic waste diversion, including systems in place to capture 75% of landfill gas. The province will also pursue efforts to make better use of waste, including bioenergy and biofuels.								
Saskatchewan Solid Waste Management Strategy*	Waste and Other	CO_2, CH_4	Reduce emissions from municipal waste and wastewater	Voluntary Agreement	Adopted	2018	Saskatchewan	NE[h]	NE[h]
Brief Description	Promote the upgrading of municipal waste and sewage management services to reduce, capture and use GHG emissions and biogas that would otherwise be released into the air, by making these projects a priority category for support under joint federal/provincial funding programs.								
Manitoba (Winnipeg) Landfill Gas Expansion	Waste and Other	CH_4	Reduce emissions from municipal waste	Voluntary Agreement	Planned	2019	Manitoba	NE[h]	39.5
Brief Description	Reduce Manitoba's emissions by expanding of methane capture technology at the Brady Road Landfill in Winnipeg. This project is co-funded by Canada under the Low Carbon Economy Fund.								
Ontario Landfill Gas Collection and Control Regulation*	Waste	CH_4	Reduce GHG emissions from the waste sector	Regulatory	Implemented	2008	Ontario	1800	NE[h]
Brief Description	Ontario regulations require large landfills to collect and control landfill gas.								
Québec Residual Materials Management Policy*	Waste and Other	CH_4	Reduce emissions from the waste sector	Regulatory	Implemented	2011	Québec	NE[h]	NE[h]
Brief Description	Québec's policy on residual waste management is aimed at creating a waste-free society that maximizes value added through sound management of Québec's residual waste, and the policy's underlying objective is to ensure that only residual waste disposed of in Québec is final waste. To help achieve this objective, the policy sets out the implementation of measures for addressing three major residual waste management issues: stop wasting resources; help achieve the objectives of Québec's action plan on climate change and energy strategy; and empower all those concerned by residual waste management. The policy is still in effect. However, its 2011-2015 action plan has not been renewed. The next five-year action plan is scheduled to start in 2020.								

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Québec Royalties (Regular and Extra) for Residual Material Disposal	Waste and Other	CH_4	Reduce emissions from the waste sector	Regulatory	Implemented	2006	Québec	NE[h]	NE[h]
Brief Description	Royalties on residual material disposal were implemented in 2006 and 2010 to reduce the quantities of eliminated residual material and also to increase the lifespan of disposal sites. The royalties also fund the preparation, implementation and revision of residual material management plans as well as the measures arising from the Québec Policy on Residual Waste Management (Politique québécoise de gestion des matières résiduelles) and the Biomethanization and compost treatment program for organic material (Programme de traitement des matières organiques par biométhanisation et compostage).								
Québec Processing organic matter using biomethane and composting Program*	Waste and Other	CH_4, CO_2	Reduce emissions in the waste sector	Economic	Implemented	2009	Québec	80	NE[h]
Brief Description	This program provides financial support to municipalities and the private sector for the development of facilities to process organic matter. The program aims to reduce the amount of organic matter and thus reduce GHG emissions. The program has been extended until 2022.								
Québec Program to Support Composting in Small Municipalities*	Waste and Other	CH_4	Reduce emissions in the waste sector	Economic	Implemented	2014	Québec	1	NE[h]
Brief Description	The Program allows small municipalities and Indigenous communities to obtain financial support for the implementation of domestic or communal composters on their territory. The program aims to reduce the amount of organic waste sent to landfills and the associated GHG emissions.								
Québec *Regulation Respecting the Landfilling and Incineration of Residual Materials**	Waste and Other	CH_4	Reduce emissions in residual materials	Regulatory	Implemented	2017	Québec	NE[h]	NE[h]
Brief Description	In 2005, the Government of Québec passed a major regulation seeking to minimize the impact of biogases coming from sanitary landfill sites. The Regulation respecting the landfilling and incineration of residual materials requires the largest technical landfill sites (i.e. those that landfill over 50,000 tonnes of residual materials per year) to capture the biogases and ideally make use of them or eliminate them.								
New Brunswick Landfill Gas Management*	Waste and Other	CH_4	Increase methane capture rate at landfills	Voluntary Agreement	Implemented	2008	New Brunswick	26	280
Brief Description	Six municipal solid waste landfills have installed approved landfill gas capture systems. Five of the six landfills are generating electricity from the biogas. This 2014-2020 voluntary agreement is implemented by New Brunswick and the Landfill Commissions.								

Name of Mitigation Action	Sector(s) Affected	GHG(s) Affected	Objective and/or Activity Affected	Type of Instrument	Status of Implementation	Start year of Implementation	Implementation Entity	Estimate of Mitigation Impact in 2020 (Kt CO_2 eq)	Estimate of Mitigation Impact in 2030 (Kt CO_2 eq)
Nova Scotia Solid Waste Resources Management Regulations*	Waste and Other	CH_4, CO_2	Increase the rate of waste diversion from landfills in Nova Scotia	Regulatory	Implemented	1996	Nova Scotia	NE[h]	NE[h]
Brief Description	Implemented in 1996, this regulation resulted in Nova Scotia having the highest waste diversion rate in Canada and includes a ban on organics entering landfills in Nova Scotia. Currently 55% of Nova Scotia organic waste is diverted from all landfills into aerobic processing, converting the potential methane from these organics to CO_2 emissions (25 times lower global warming potential).								
Prince Edward Island Waste Watch*	Waste and Other	CH_4	Reduce methane generation from landfill	Voluntary Agreement	Adopted	2002	Prince Edward Island	NE[h]	NE[h]
Brief Description	Prince Edward Island is a national leader in sustainable waste management practices through its innovative Waste Watch program. It offers a curbside three source separation system (waste, compost, and recyclables) to all residents. The Waste Watch program was launched province-wide in 2002 by the Island Waste Management Corporation, a provincial crown corporation. The program successfully diverts as much as 65% of waste produced by Islanders from disposal in landfill. Compostable waste is diverted to a central compost facility.								
Newfoundland and Labrador measures to reduce emissions from waste*	Waste and Other	CH_4	Reduce methane generation from landfill	Regulatory	Adopted	2002	Newfoundland and Labrador	NE[h]	NE[h]
Brief Description	Includes measures to reduce landfill volumes, increase composting, destroy methane and allow for biogas electricity generation.								
AGRICULTURE									
Agricultural Clean Technology Program	Agriculture	CO_2, CH_4, N_2O	Support research on GHG mitigation and make new mitigation technologies available to farmers	Research	Implemented	2018	Agriculture and Agri-Food Canada, Provincial and Territorial Governments	NE[d]	NE[d]
Brief Description	The Agricultural Clean Technology Program, a $25 million, three-year initiative (2018-2021), supports investments made by provincial and territorial governments to lower greenhouse gas emissions from agricultural production through research, development and adoption of clean technologies for the agriculture sector through precision agriculture and agri-based bioproducts. These technologies will help to reduce GHG emissions, generate a wide range of positive impacts, and promote sustainable and clean growth.								

Name of Mitigation Action	Sector(s) Affected	GHG(s) Affected	Objective and/or Activity Affected	Type of Instrument	Status of Implementation	Start year of Implementation	Implementation Entity	Estimate of Mitigation Impact in 2020 (Kt CO_2 eq)	Estimate of Mitigation Impact in 2030 (Kt CO_2 eq)
Agricultural Greenhouse Gases Program	Agriculture	CO_2, CH_4, N_2O	Support research on GHG mitigation and make new mitigation technologies available to farmers	Research	Implemented	2010	Agriculture and Agri-Food Canada	NE[d]	NE[d]
Brief Description	The Agricultural Greenhouse Gases Program supports innovative research projects that develop technologies, practices and processes that can be adopted by farmers to mitigate GHG emissions. A first phase of the program ran from 2010-2015 ($27 million) and the second phase of the program (2016-2021), extends Canada's commitment to support the objectives of the Global Research Alliance on Agricultural Greenhouse Gases. This new $27 million five year commitment will be funding twenty projects that will create technologies, practices and processes that can mitigate additional greenhouse gas emissions. Most projects are led by Canadian universities across the country and fall under one or more of the following four priority areas: livestock systems, cropping systems, agricultural water use efficiency, and agroforestry.								
Canadian Agricultural Partnership (the Partnership)	Agriculture	CO_2, CH_4, N_2O	Reduce GHG emissions from the agricultural sector	Education	Implemented	2018	Agriculture and Agri-Food Canada, Provincial and Territorial Governments	NE[e]	NE[e]
Brief Description	The Partnership, launched April 1, 2018, is a five-year, $3 billion investment by federal, provincial and territorial governments to strengthen the agriculture and agri-food sector. Through the Partnership, provinces and territories design and manage delivery of cost-shared environmental stewardship programs to support Environmental Farm Plans and adoption of best management practices such as cover crops, precision nutrient application, equipment for reduced tillage seeding and enhanced irrigation efficiency.								
The Partnership Federal-Only Program: AgriInnovate	Agriculture	CO_2, CH_4, N_2O	Support the reduction of GHG emissions from the agricultural sector	Research	Implemented	2018	Agriculture and Agri-Food Canada	NE[d]	NE[d]
Brief Description	The AgriInnovate program aims to accelerate the commercialization, adoption and/or demonstration of innovative products, technologies, processes or services that increase sector competitiveness and sustainability. Priority areas under AgriInnovate include: adoption of new or world leading clean technology, including precision agriculture; and increased productivity through advanced manufacturing, automation or robotics.								

Name of Mitigation Action	Sector(s) Affected	GHG(s) Affected	Objective and/or Activity Affected	Type of Instrument	Status of Implementation	Start year of Implementation	Implementation Entity	Estimate of Mitigation Impact in 2020 (Kt CO_2 eq)	Estimate of Mitigation Impact in 2030 (Kt CO_2 eq)
The Partnership Federal-Only Program: AgriScience	Agriculture	CO_2, CH_4, N_2O	Support research on GHG mitigation and make new mitigation technologies available to farmers	Research	Implemented	2018	Agriculture and Agri-Food Canada	NE[e]	NE[e]
Brief Description	The AgriScience program (2018-2023) aims to accelerate the pace of innovation by providing funding and support for pre-commercial science activities and cutting-edge research that benefits the agriculture and agri-food sector and Canadians. Priority areas under AgriScience include: addressing environmental challenges and adaptation to changing climate, agricultural impacts on air, water and soil; reducing GHG emissions; transforming agricultural products into biofuels; and water management and soil management.								
British Columbia Nutrient Management Program	Agriculture	N_2O	Reduce GHG emissions from the agricultural sector	Education, Research	Implemented	2015	British Columbia	NE[h]	NE[h]
Brief Description	The Nutrient Management Program promotes the right amount, form, placement, and timing of fertilizers and manure to optimize crop growth and minimize the environmental impacts of nutrient application, including GHG emissions and nitrate leaching into ground water. This program includes: expanding trials to develop and demonstrate nutrient management best practices to the agriculture industry; increasing funding to the sector to implement beneficial management practices that promote better nutrient management and further reductions in GHG emissions; and nutrient management planning to help producers improve nutrient applications and meet new environmental regulations under the new Agricultural Environmental Management Code of Practice.								
Saskatchewan Agriculture Water Management Strategy	Agriculture	N_2O	The program supports responsible drainage to reduce direct N_2O emissions from agricultural runoff and enhances carbon sequestration by conserving wetland habitats	Regulatory	Implemented	2018	Saskatchewan	NE[h]	NE[h]
Brief Description	Saskatchewan's agricultural water management framework assures continued productivity, enhances wetland habitat conservation and improves runoff management in times of both drought and flood. Saskatchewan provided funding of $922,250 to Watershed groups and community groups to assist in agricultural water management implementation. Wetlands are natural carbon sinks; this strategy helps preserve these sinks and prevents stored GHGs from entering the atmosphere. Similarly, responsible drainage of water on cropland can facilitate efficient application of nitrogen-based fertilizers and reduce the amount of fertilizer that is lost to the atmosphere as N_2O due to volatilization.								

Name of Mitigation Action	Sector(s) Affected	GHG(s) Affected	Objective and/or Activity Affected	Type of Instrument	Status of Implementation	Start year of Implementation	Implementation Entity	Estimate of Mitigation Impact in 2020 (Kt CO_2 eq)	Estimate of Mitigation Impact in 2030 (Kt CO_2 eq)
Saskatchewan Landscape Integrity Program	Agriculture	CO_2, CH_4, N_2O	Reduce emissions from agriculture and increase resiliency to climate change	Education, Regulatory, Voluntary Agreement	Implemented, Planned	2018 - 2023	Saskatchewan	NE[h]	NE[h]
Brief Description	Provides eligible Saskatchewan producers with financial assistance to implement Beneficial Management Practices of manure management, which requires operations that feed and house livestock under confined conditions to develop manure storage and management plans that reduce GHG emissions.								
Ag Action Manitoba Program - Assurance	Agriculture	CO_2, CH_4, N_2O	Reduce emissions and co-benefits	Voluntary Agreement	Implemented	2018	Manitoba	NE[h]	NE[h]
Brief Description	In 2018, Ag Action Manitoba announced program funding to help farmers implement and adopt beneficial management practices on their farm identified in their Environmental Farm Plan. These practices support reducing emissions among other benefits. The Ag Action Manitoba program is a five-year investment of $176 million to Manitoba's agriculture and agri-food sector, and supports the growth and sustainability of primary agriculture in Manitoba, with funding available for: developing new skills, technologies and products; increasing production and adding value to their products; finding new markets; improving plant and animal health; supporting environmental sustainability; and supporting basic and applied research and development. Conservation districts can apply to the Ag Action Manitoba program activity called Assurance, which includes Watershed Ecological Goods and Services, and provides funding to conservation districts to work with farmers to implement practices that conserve and enhance ecological goods and services on the agricultural landscape.								
Manitoba 4R Nutrient Stewardship System	Agriculture	N_2O	Reduce emissions and enhance emission sequestration, and co-benefits (water quality)	Voluntary Agreement	Implemented	2018	Manitoba	NE[h]	NE[h]
Brief Description	In 2018, the Government of Manitoba, Fertilizer Canada and Keystone Agricultural Producers renewed their partnership to promote 4R Nutrient Stewardship as the leading approach to sustainable nutrient beneficial management practices in the province. The Memorandum of Understanding links the Government of Manitoba's objectives for environmental performance with the 4R Nutrient Stewardship programming developed by Canada's fertilizer industry and ensures continued commitment to agricultural sustainability in Manitoba.								
Québec Fertilizer Testing Support Program	Agriculture	CO_2, CH_4, N_2O	Reduction of GHG emissions in the agriculture sector	Economic	Implemented	2013	Québec	NE[h]	NE[h]
Brief Description	This initiative aims to support crop producers in the implementation of crop fertilization trial projects that will adjust fertilizer reference grids in line with today's realities.								

Name of Mitigation Action	Sector(s) Affected	GHG(s) Affected	Objective and/or Activity Affected	Type of Instrument	Status of Implementation	Start year of Implementation	Implementation Entity	Estimate of Mitigation Impact in 2020 (Kt CO_2 eq)	Estimate of Mitigation Impact in 2030 (Kt CO_2 eq)
Prince Edward Island Alternative Land Use Services Program	Agriculture	CO_2, N_2O	Remove environmentally sensitive land from production	Economic	Implemented	On-going	Prince Edward Island	NE[h]	NE[h]
Brief Description	Alternative Land Use Services Program provides agricultural landowners with assistance to remove environmentally sensitive land from production and includes expanding buffer zones and grassed headlands, and retiring high-sloped land. Currently, the program supports the removal of over 2,800 hectares of farm land from production.								
Prince Edward Island Winter Cover Crop Funding Programs	Agriculture	CO_2, N_2O	Establish winter cover crops to sequester carbon and limit N_2O emissions	Economic	Implemented	2023	Prince Edward Island	2	2
Brief Description	The Winter Cover Crop program (funded through the Canadian Agricultural Partnership) is available to farmers to reduce nutrient loss in the soil, but also has influences on carbon sequestration and direct and indirect losses of nitrous oxide. This program recently expanded it scope to include any type of cover crop following the "primary" crop. A per acre incentive is provided with almost 1,000 acres currently committed for 2019. The program has the capacity to include additional acreage this year. The program, with its expanded scope will continue in 2020 with capacity to support about 1,500 acres. This program is funded, in part, by the Canadian Agricultural Partnership.								
LULUCF									
Forest Bioeconomy Framework for Canada	LULUCF	CO_2	Reduce GHG emissions and advance innovation in the forest sector	Voluntary Agreement	Implemented	2017	Natural Resources Canada, provincial and territorial governments	NE[d]	NE[d]
Brief Description	In September 2017, the federal, provincial and territorial governments, working together through the Canadian Council of Forest Ministers, launched a Forest Bioeconomy Framework for Canada. This framework will position Canada to become a global leader in the use of forest biomass for advanced bio-products and innovative solutions. The Framework presents an integrated approach to meeting climate change mitigation commitments and advancing innovation in the forest sector for the long term. It affirms federal, provincial and territorial government commitments to work in partnership with forest communities and industry stakeholders, including continually engaging Indigenous Peoples. The plan is expected to generate indirect, rather than direct, emissions reductions.								
Low Carbon Economy Fund projects related to the forestry sector	LULUCF	CO_2, CH_4, N_2O	Remove GHG emissions	Economic	Implemented	2017	Environment and Climate Change Canada	NE[c]	NA[c]
Brief Description	The Government of Canada's Low Carbon Economy Fund provides support to projects that allow the forestry sector to enhance stored carbon in forests. For example, through the Low Carbon Economy Leadership Fund provides federal support for British Columbia's Forest Carbon Initiative that includes measures to reduce slash burning, restore forests, and use harvest residues. The mitigation impacts for this action are included under the overarching estimate for the Low Carbon Economy Leadership Fund.								

Name of Mitigation Action	Sector(s) Affected	GHG(s) Affected	Objective and/or Activity Affected	Type of Instrument	Status of Implementation	Start year of Implementation	Implementation Entity	Estimate of Mitigation Impact in 2020 (Kt CO_2 eq)	Estimate of Mitigation Impact in 2030 (Kt CO_2 eq)
British Columbia Forest Carbon Initiative	LULUCF	CO_2, CH_4, N_2O	Enhance forest carbon removals and reduce emissions	Economic	Implemented	2017	British Columbia	NE[h]	NE[h]
Brief Description	BC's $290 million Forest Carbon Initiative is using a portfolio approach to enhance the carbon sequestration capacity of BC's forests with the rehabilitation of wildfire and mountain pine beetle sites, and other areas where there is no legal obligation for replanting. The initiative aims to increase planting density and the use of residual wood, to improve the use of forest fibre for biofuels and longer-lived wood products, and to promote sustainable forestry practices.								
British Columbia Forest Carbon Offsets	LULUCF	CO_2	Increase carbon stocks through sustainable forest management and conservation	Regulatory	Implemented	2017	British Columbia	950	910
Brief Description	British Columbia pursues offsets in the forestry sector, an example of which being the Great Bear Rainforest Forest, which, supports a strict new ecosystem-based management regime and protects 85% of the 6.4 million hectare area. Offsets are purchased by the Province as part of the Carbon Neutral Government Program.								
Saskatchewan Forest Management on Commercial Forest Lands	LULUCF	CO_2	Increase carbon sequestration	Voluntary Agreement, Regulatory, Education	Implemented	2018 - 2020	Saskatchewan	NE[h]	NE[h]
Brief Description	Ensure natural and commercially forested lands are managed in a manner that enhances the removal and storage of carbon from the atmosphere while allowing for sustainable harvesting, respecting normal forest cycles and fire preparedness.								
Saskatchewan SaskPower Shand Greenhouse Seedlings	LULUCF	CO_2	Mitigate GHG emissions from SaskPower's use of fossil fuels to produce electricity	Voluntary Agreement	Implemented	1992	Saskatchewan	111	129
Brief Description	The SaskPower Shand Greenhouse grows and distributes tree, shrub and native plant seedlings utilizing waste heat from the adjacent coal-fired generating station. Typical annual production is 500,000 seedlings. Each production cycle is estimated to contribute 3.3 to 5.6 Kt of CO_2 eq sequestration per year of growth. It is estimated that 1348 Kt CO_2 eq will have been cumulatively sequestered due to seedling production and associated plantings in the period from 1992 to 2020 and that 2669 Kt CO_2 eq will have been cumulatively sequestered in the period from 1992 to 2030.								

Name of Mitigation Action	Sector(s) Affected	GHG(s) Affected	Objective and/or Activity Affected	Type of Instrument	Status of Implementation	Start year of Implementation	Implementation Entity	Estimate of Mitigation Impact in 2020 (Kt CO_2 eq)	Estimate of Mitigation Impact in 2030 (Kt CO_2 eq)
Manitoba Growing Outcomes in Watersheds Program	LULUCF	CO_2, N_2O	Reduce emissions and enhance emissions sequestration, and co-benefits water management, biodiversity, etc.	Voluntary Agreement	Implemented	2019	Manitoba	NE[h]	NE[h]
Brief Description	The Growing Outcomes in Watersheds Program supports emissions reduction and sequestration. The trust was established with an initial investment of $52 million and commitment for another $50 million made later in 2019. The program will help producers and ranchers with projects such as restoring wetlands, planting windbreaks and balancing drainage with water retention. Benefits include improved water management, enhanced sustainable agricultural production, improved biodiversity and habitat, and carbon sequestration and storage.								
Manitoba Conservation Trust	LULUCF	CO_2, N_2O	Increase carbon sequestration and other benefits (reduce flooding and drought vulnerability, improve water quality, etc.)	Voluntary Agreement	Implemented	2018	Manitoba	NE[h]	NE[h]
Brief Description	The $102 million Conservation Trust established in 2018 supports programs related to conserving ecosystems, enhancing natural infrastructure, improving water quality, and strengthening flood and drought mitigation and adaption to the impacts of climate. The program supports increasing carbon sequestration.								
Québec Wood Innovation Workplan	LULUCF	CO_2	Support the transformation and modernization of the forest products industry	Economic	Implemented	2016	Québec	NE[h]	NE[h]
Brief Description	Québec's Wood Innovation Work Plan supports the transformation and modernization of the forest products industry, with over $86 million in government investments by 2022. Work plan consists of nearly 40 measures to support the transformation and modernization of the forest products industry. Québec also began a Wood Innovation Program in 2015 to encourage applied research, demonstration and implementation of innovative products, processes and systems in the forest products industry.								

Name of Mitigation Action	Sector(s) Affected	GHG(s) Affected	Objective and/or Activity Affected	Type of Instrument	Status of Implementation	Start year of Implementation	Implementation Entity	Estimate of Mitigation Impact in 2020 (Kt CO_2 eq)	Estimate of Mitigation Impact in 2030 (Kt CO_2 eq)
Prince Edward Island Carbon Capture Tree Planting Program	LULUCF	CO_2	Sequester carbon through tree planting	Economic	Planned	2022	Prince Edward Island	NE[b]	8.6
Brief Description	The Carbon Capture Tree Planting program—an initiative to plant native tree species on about 250 hectares of abandoned or marginal public and private land—was launched earlier this year. At the end of March 2019, 40 landowners had applied to participate and 45 hectares of trees will be planted in 2019-2020. The J. Frank Gaudet Nursery will begin growing trees for planting on 90 hectares next year. This project is funded in part by the Government of Canada's Low Carbon Economy Leadership Fund.								

*Denotes a policy that was explicitly modeled in the 'with measures' scenario in Chapter 5

** Denotes a policy that was explicitly modeled in the 'with additional measures' scenario in Chapter 5

[1] Estimated reductions from carbon pricing across Canada. These are scenarios only. Emission reductions may vary depending on how proceeds are returned and the price trajectory post-2022.

NA = Not applicable

NE = Not estimated

a) Impacts in 2020 and/or 2030 are expected to be minimal
b) The measure is not expected to be in place in 2020/2030
c) Emissions reductions of this measure are aggregated into the estimates of another overarching measure
d) The measure is expected to generate indirect, rather than direct emissions reductions
e) The details of the policy are still under development. Therefore, at this time it is premature to estimate the mitigation impact.
f) The measure contributes to the Government of Canada's efforts transition to a low carbon economy by fostering the growth of Canadian clean technologies and companies. Although mitigation impacts cannot be directly attributed to this measure, it may have an indirect impact on GHG emissions.
g) The funding is yet to be distributed. Since decisions have not yet been made on the projects to be funded, it is premature to estimate the mitigation impact.
h) The province or territory did not provide an estimate at the time of submission

ANNEX 2 PROJECTIONS AND THE TOTAL EFFECT OF POLICIES AND MEASURES

A2.1 Detailed Results

A2.1.1 Comparing Activity Sector Categories to Economic Sectors

Table 5.1 in Chapter 5 illustrates how the projected trends in GHG emissions vary by economic sector. This is a result of the expected evolution of the key drivers of emissions in each sector, as well as various government and other initiatives. For example, in the transportation sector, growing economic activity in Canada affects the number of freight trucks on the road, thus emissions from the freight transportation subsector are projected to rise. However, more than offsetting this trend are the Government of Canada's Light-duty vehicles (LDV) GHG emissions standards for the LDV model years 2011 to 2025, which are causing the average emissions intensity for all on-road passenger vehicles to decline through the projection period[25]. For the electricity sector, emissions are expected to fall, largely due to the combined impact of various government measures to create a cleaner electricity system, predominately by replacing coal-fired generation with lower-emitting natural gas and non-emitting sources.

Some adjustments that are made to the IPCC categories to calculate economic sector emissions include:

- Reallocating off-road transportation emissions related to farming (primarily farm tractors and other mobile machinery) to the agriculture sector instead of transportation.
- Reallocating off-road transportation emissions related to mining operations from transportation to the oil and gas sector and the heavy industry[26] sector.
- Reallocating emissions related to pipeline operations to the oil and gas sector.
- Reallocating some of the industrial process emissions to the buildings sector.

In addition, stationary combustion emissions under the IPCC categorisation are allocated across economic sectors, as appropriate. Almost all industrial process and fugitive emissions under these processes are aligned with the economic sector that generates them (primarily in the heavy industry and oil and gas sectors). In addition, emissions from landfills are included in the waste and others sector. For a more detailed description of the reconciliation between economic and IPCC sector categories, please see Chapter 3: Canada's Greenhouse Gas Inventory.

Figure A2.1 shows the distribution of 2017 emissions on an IPCC activity basis versus an economic sector basis.

25 The projections are based on the current light duty vehicle legislated emissions standards. The Government of Canada is consulting on the mid-term review of these standards.

26 Heavy industry subsectors include mining activities, smelting and refining, and the production and processing of industrial goods such as chemicals, fertilizers, pulp and paper, aluminum, iron and steel and cement.

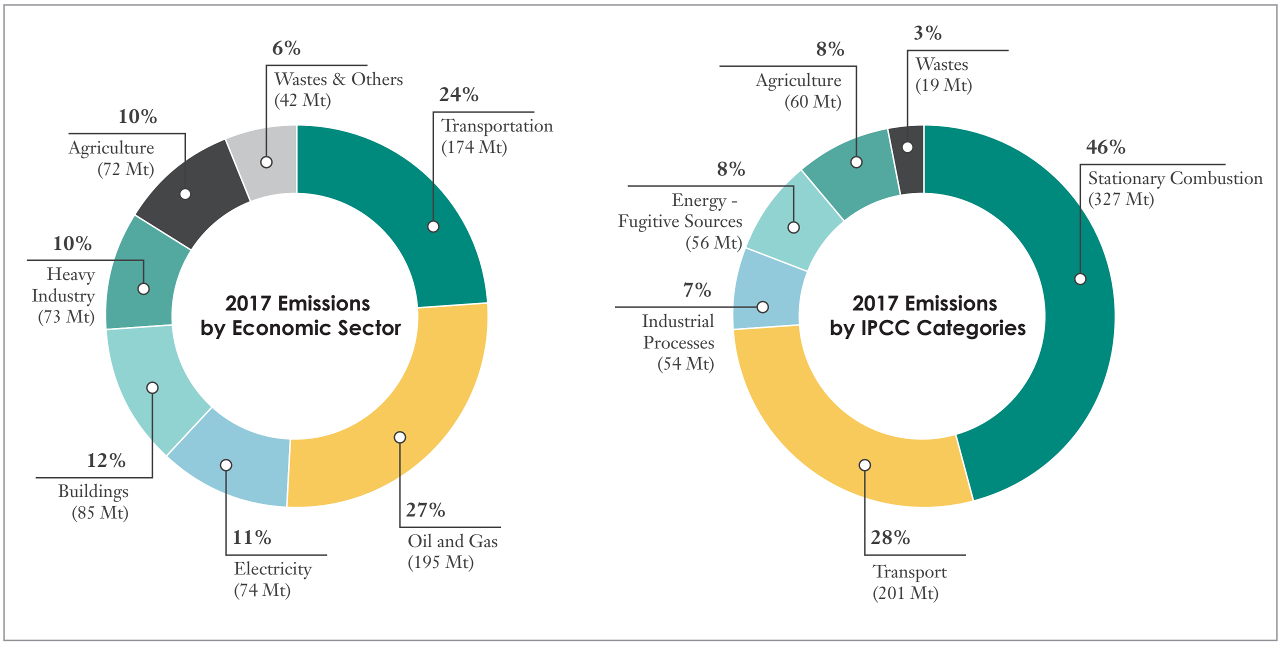

Figure A2.1: Total Canadian 2017 GHG emissions (722 Mt CO_2 eq)—Methods of Categorisation

A2.1.2 Detailed Results for With Measures Scenario

A2.1.2.1 Emissions by Sector

A2.1.2.1.1 Oil and Gas

Production, pipeline transportation, processing, refining, and distribution of oil and gas products all contribute to the emissions of the oil and gas sector. In 2017, the oil and gas sector produced the largest share of GHG emissions in Canada, approximately 27%.

Since 2005, GHG emissions from the oil and gas sector have increased reflecting the growth in production due to increased development and evolving technologies in oil sands operations, from 158 Mt in 2005 to 195 Mt in 2017—a 23% increase as shown in Table A2.1. Increased emissions from unconventional oil sands activity have been partly offset by the gradual depletion of conventional oil and natural gas reserves in Canada and limited expansion of the refining sector. Government measures, such as recently published regulations on methane emissions in the upstream oil and gas sector, the Energy Innovation Program and the LCEF Challenge Fund will further constrain increases in emissions over the projection period. Emission projections in the oil and gas sector are driven by the Canada Energy Regulator's (CER) projections of oil and natural gas prices as well as the CER's corresponding estimates of production.

Table A2.1: Oil and Gas Sector Emissions (Mt CO_2 eq) from 2005 to 2030

	Historical				Projected		Change 2005 to 2030
	2005	2010	2015	2017	2020	2030	
Natural Gas Production and Processing	57	49	52	50	45	38	-19
Conventional Oil Production	30	26	36	31	32	28	-2
Light Oil Production	11	11	19	18	15	14	3
Heavy Oil Production	17	14	16	12	15	12	-5
Frontier Oil Production	2	2	2	2	2	1	0
Oil Sands*	36	54	71	81	94	110	75
Bitumen In Situ	11	20	33	42	49	64	52
Bitumen Mining	9	13	14	16	21	22	13
Bitumen Upgrading	16	21	23	22	24	25	9
Oil and Natural Gas Transmission	12	7	10	10	10	10	-2
Downstream Oil and Gas	23	23	22	23	24	24	1
Petroleum Products	22	22	21	22	23	23	1
Natural Gas Distribution	1	1	1	1	1	1	0
Liquid Natural Gas Production	0	0	0	0	0	2	2
Total	**158**	**159**	**192**	**195**	**206**	**213**	**55**

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

* Based on the Alberta Government's announcement, Alberta's 100 Mt cap on oil sands emissions excludes emissions from cogeneration of electricity and new upgrading. When omitting these, total emissions from oil sands is about 100Mt by 2030 under the WM scenario.

Upstream Oil and Gas Production

In Table A2.2, upstream oil and gas includes the extraction, production, and processing of both conventional and unconventional oil and gas. In previous reports oil production from conventional sources was expected to slow down over time, replaced by increasing production from oil sands. In the last two years these expectations have changed, with fast expanding thermal heavy oil production in Saskatchewan and higher drilling efficiencies throughout the conventional crude oil sector. Hebron, a new offshore platform in Newfoundland and Labrador that came online in 2017, is also contributing to additional output in conventional oil.

Table A2.2: Upstream Oil and Natural Gas Production: Emissions and Drivers

	Historical				Projected	
	2005	2010	2015	2017	2020	2030
Conventional Oil Production						
Emissions (Mt CO_2 eq)	30	26	35	28	32	28
Production (1000 barrels/day)	1360	1227	1265	1215	1424	1601
Emissions Intensity (Kg CO_2 eq /bbl)	59.9	58.7	74.8	64.1	61.2	47.3
Oil Sands (Excluding Upgraders)						
Emissions (Mt CO_2 eq)	20	33	50	64	70	86
Production (1000 barrels/day)	1065	1612	2526	2838	3277	4105
Emissions Intensity (Kg CO_2 eq /bbl)	51.5	55.2	54.2	61.4	58.5	57.1

	Historical				Projected	
	2005	2010	2015	2017	2020	2030
Natural Gas Production and Processing						
Emissions (Mt CO_2 eq)	57	49	51	47	45	38
Production (1000 barrels/day)	7221	6247	6320	6477	6700	7446
Emissions Intensity (Kg CO_2 eq /bbl)	21.5	21.3	22.3	19.7	18.4	14.0

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

Emissions from upstream oil and gas production are estimated to grow from 139 Mt in 2017 to 151 Mt in 2030. This increase is driven by the growth in bitumen production from the oil sands, where emissions are expected to increase from 64 Mt in 2017 to 86 Mt by 2030 (excluding emissions from upgraders). Specifically, emissions from oil sands mining are projected to increase by 5 Mt and in situ production emissions are expected to increase by 17 Mt.

As part of the Pan-Canadian Framework, the Government of Canada implemented regulations to reduce methane emissions from the oil and gas sector by 40 to 45 %from 2012 levels by 2025. The regulations are included in these projections, driving GHG emissions reductions of about 20 Mt of CO2 eq by 2030.[27]

Emissions from conventional crude oil production are expected to remain flat at 28 Mt from 2017 to 2030. However, it is worth noting that production of conventional crude oil is increasing throughout the projection period, albeit at a relatively less intensive rate relative to the historical period. Emissions from natural gas production and processing are also expected to decline from 47 Mt in 2017 to 38 Mt in 2030. Emission intensities in conventional crude oil and natural gas production and processing are projected to decline as a result of policies such as Clean BC and the Federal Methane Regulations, which reduce the overall intensities of both extraction and processing.

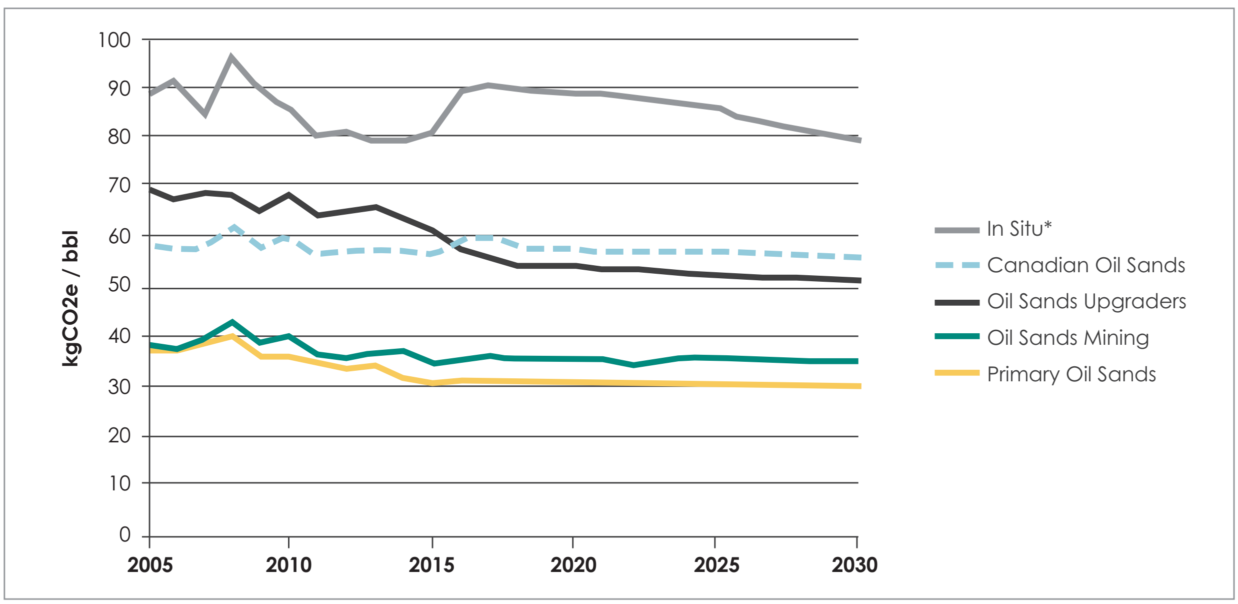

Figure A2.2: Canadian Oil Sands Emissions Intensity
* In situ comprises production from Cyclic Steam Stimulation (CSS) and Steam Assisted Gravity Drainage (SAGD).

27 https://pollution-waste.canada.ca/environmental-protection-registry/regulations/view?Id=146.

Oil production from unconventional sources continues to grow. In general, extracting oil from oil sands via an in situ method (e.g., using in-ground techniques to separate the oil from the sand) is more emissions-intensive than oil sands mining (Figure A2.2). Production growth in the oil sands sector between 2005 and 2017 resulted in growing emissions and this trend is expected to continue to 2030.

In the historical period overall bitumen extraction emissions intensity has remained relatively flat while bitumen production increased by about 8 %per year between 2005 and 2017. In Figure A2.2 emissions intensity for Canadian oil sands bitumen extraction peaked at 62 kgCO2e / bbl in 2008 before declining slightly to 60 kgCO2e /bbl in 2017. Emissions intensities have increased in the oil sands from 2015 to 2017 largely due to increased cogeneration from the In Situ sectors.

In the forecast, several factors could lead to increasing emissions intensity in the oil sands subsector, such as declining reservoir quality, aging of existing facilities, and shifts from mining operations to more emissions-intensive in situ extraction processes. On the other hand, the deployment of emerging technologies in the oil sands could lead to significant emissions intensity reductions in the subsector. Considering the uncertainties associated with these counterbalancing trends in oil sands emissions intensities, the projections keep the emissions intensities of future oil sands production at the level of existing technologies. Possible technological advancements envisioned in SAGD are included in the Technology Scenario and presented in Section 5.2.2.

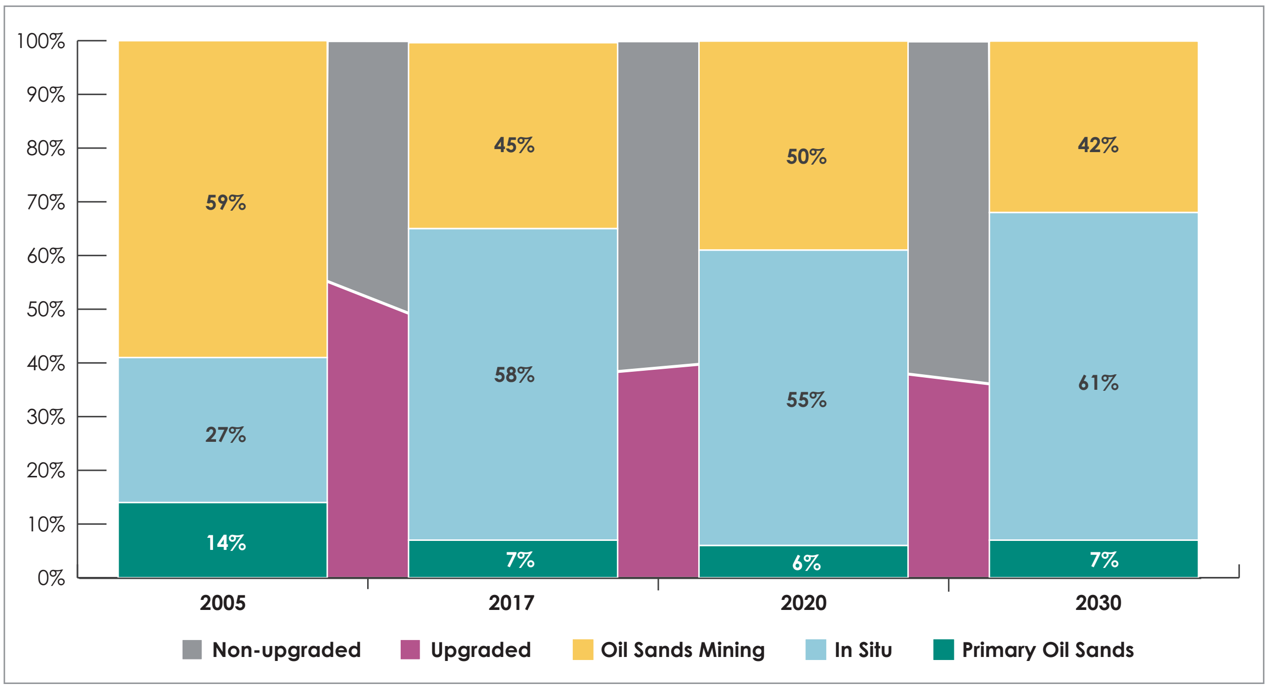

Figure A2.3: Oil Sands Production

Innovations in the In Situ subsector have contributed to a slower growth in emissions intensity in the oil sands, despite growing production. However, the 2016 Fort McMurray wildfires brought considerable interruptions to activities in the oil sands sector causing emissions intensities to rise in 2016. As depicted in Figure A2.3, In Situ production rose from 27% in 2005 to 58% in 2017 and is expected to contribute 61% of total oil sands production by 2030. At the same time, production from oil sands mining declined from 59% in 2005 to 45% of total oil sands production in 2017 and is expected to stay relatively flat in the projection period.

In addition, emissions from oil sands sectors are increasing throughout the projection period in part due to increased cogeneration activity to meet electricity and steam demands. Planned increases in cogeneration in the oil sands is forecasted to displace generation and emissions in the electricity sector. Most notably, Suncor Base Plant is expected to replace petroleum coke boilers with a natural gas cogeneration plant, and sell excess electricity to the Alberta grid beginning in 2023. Increasing cogeneration from industry and its effect on emissions throughout the Canadian economy is further discussed in Section A.1.2.1.3 of the report.

Transportation and Distribution of Oil and Gas

Emissions presented in Table A2.1 from Oil and Natural Gas Transmission and Natural Gas Distribution are projected to remain relatively flat in the forecast. The CER in their Canada's Energy Futures 2019 report assume that infrastructure required for the transportation and distribution of oil and gas products over the short-to-medium term is constant while in the long term infrastructure is built as needed[28]. As such, emissions from the transportation and distribution of oil and gas products are likely to remain somewhat constant in the medium term and grow as pipeline capacity expands.

Petroleum Refining and Upgrading

Table A2.3 displays emissions associated with petroleum refining and upgrading sector from 2005 to 2030. Emissions from traditional petroleum refining stay relatively unchanged over the projection period, and emission intensity from conventional refineries remains steady at 30 $kgCO_2eq$ / bbl between 2017 and 2030.

The 2016 forest fires in Alberta and the deployment of Carbon Capture and Storage (CCS) under the Quest Project at Fort Saskatchewan, Alberta, reduced emissions from Upgraders in 2016. However, emissions associated with the upgrading of oil sands bitumen are expected to slightly increase from 23 Mt in 2017 to 25 Mt by 2030, largely driven by additional capacity in Western Canada.

Muted growth in emissions between 2010 and 2020 from upgraders, even as output increases, is due to the expanding use of CCS technology at upgrading facilities such as the Quest Project at Fort Saskatchewan, Alberta. In addition, the 240 kilometre Alberta Carbon Trunk Line (ACTL) could enhance the capture, storage and use of significant quantities of carbon dioxide in oil sands operations. Enhance Energy, the owner and operator of the ACTL, has already agreed to source and use carbon dioxide for Enhanced Oil Recovery from Nutrien, a fertilizer plant, and Sturgeon Refinery, an upgrading and refining facility in Edmonton, Alberta.

This report shows that emission intensity in the sector has declined between 2005 and 2017 and is projected to decline from 55.7 $kgCO_2eq$ / bbl in 2017 to 51.0 $kgCO_2eq$ / bbl by 2030. Nonetheless, if there are expansions in the deployment of CCS technology in the Upgraders subsector, then emissions and emission intensity could be further constrained over the long-term.

Table A2.3: Petroleum Refining and Upgrading Sector Emissions and Drivers

	Historical				Projected	
	2005	2010	2015	2017	2020	2030
Traditional Refineries						
Emissions (Mt CO2 eq)	22	22	21	22	23	23
Refined Petroleum Processed (1000 barrels/day)	1992	1956	1835	1946	2002	2082
Emissions Intensity (Kg CO2 eq /bbl)	29.8	30.3	31.2	30.4	31.6	29.6
Upgraders						
Emissions (Mt CO2 eq)	16	21	24	23	24	25
Refined Petroleum Processed (1000 barrels/day)	611	849	1058	1113	1243	1335
Emissions Intensity (Kg CO2 eq /bbl)	69.6	68.1	60.9	55.7	54.0	51.0

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

28 https://www.cer-rec.gc.ca/nrg/ntgrtd/ftr/2019/index-eng.html

A2.1.2.1.2 Transportation

In 2017, transportation (including passenger, freight, and residential and commercial off-road emissions) was the second largest contributor to Canada's GHG emissions, representing 24% of overall GHGs.

Total transportation emissions increased from 162 Mt in 2005 to 174 Mt by 2017. The increasing fuel efficiency of light-duty vehicles has partly offset the effects of a growing economy and population putting more vehicles on the road and resulting in more kilometres (km) driven. For example, between 2005 and 2017, the sales-weighted on-road fuel efficiency for new gasoline cars improved from 9.2 litres (L) per 100 km to 8.0 L/100 km, while the sales-weighted on-road fuel efficiency for new gasoline light trucks improved from 13.2 L/100 km to 11.1 L/100 km.

Transportation emissions are however projected to drop to 153 Mt by 2030, a marked decline due primarily to the projected increases in fuel-efficiency of on-road vehicles. This change from historical trends is being driven by the federal LDV[29] regulations, as well as by the impact of carbon pricing on the sector, which are expected to more than offset the impact of a growing population and economy. Emissions are projected to decrease by 16 Mt between 2020 and 2030 as the stock of existing vehicles is gradually turned over with more efficient gasoline and diesel vehicles as well as with an increasing share of zero emission vehicles (ZEV). The federal heavy-duty vehicle (HDV) GHG emissions standards parts 1 and 2 will also contribute to increased fuel-efficiency of on road freight vehicles and a decline in emissions. The projections also include the impact of public transit investments.

As depicted in Table A2.4, the transportation sector comprises several distinct subsectors: passenger, freight, air and others (e.g., rail and marine). Each subsector exhibits different trends during the projection period. For example, emissions from passenger transportation are projected to decrease by 20 Mt between 2005 and 2030, while those for ground freight, off-road and other vehicles are projected to grow by 14 Mt over the same period.

Table A2.4: Transportation: Emissions by Subsector (Mt CO_2 eq) from 2005 to 2030

	Historical				Projected		Change 2005 to 2030
	2005	2010	2015	2017	2020	2030	
Passenger Transport	90	89	92	94	88	70	-20
Cars, Light Trucks and Motorcycles	82	82	83	85	79	61	-21
Bus, Rail and Domestic Aviation	8	8	8	8	9	9	1
Freight Transport	62	70	73	72	73	73	11
Heavy Duty Trucks, Rail	54	63	68	66	68	68	14
Domestic Aviation and Marine	8	8	6	5	5	5	-3
Other: Recreational, Commercial and Residential	10	10	9	9	9	10	0
Total	**162**	**170**	**174**	**174**	**170**	**153**	**-9**

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

In October 2010, the Government of Canada released the Light-duty vehicles (LDV-1) GHG emissions standards, which prescribe progressively more stringent annual emission standards for new vehicles of model years 2011 to 2016. In September 2014, the Government released the Light-duty vehicles 2 (LDV-2) GHG emissions standards for model years 2017 to 2025.

These regulations will achieve significant and sustained GHG reductions and fuel-savings benefits. By 2020, it is estimated that Canadian regulations for model years 2011 to 2016 will lead to annual reductions of between 9 and 10 Mt. For model years 2017 to 2025, the regulations will reduce GHG emissions by an additional 3 Mt in 2020, leading to a reduction of 24 Mt by 2030, as these new efficient vehicles replace the existing stock.

29 The projections are based on the current light duty vehicle legislated emissions standards. The Government of Canada is consulting on the mid-term review of these standards.

Under both phases of light-duty vehicle (LDV) regulations spanning model years 2011 to 2025, the fuel efficiency of new cars will increase by 41%, as compared to model year 2010 (and 50% compared to the 2008 model year), and the fuel efficiency of new passenger light trucks will increase by 37%. The sales-weighted fuel efficiency of new cars is projected to improve from 8.6 L/100 km in 2010 to 6.4 L/100 km in 2020, and to 5.1 L/100 km by 2025. The sales-weighted fuel efficiency of new passenger light trucks are projected to improve from 12.0 L/100 km in 2010 to 9.1 L/100 km in 2020, and to 7.6 L/100 km by 2025. In addition, the LDV regulations are driving the shift away from the use of HFCs in mobile air conditioners, resulting in a significant decrease in emissions of this gas with high global warming potential. See Table A2.17 for trends in HFC emissions.

Additional measures targeting light duty vehicles in passenger transportation include the Government of Canada's Incentives for Zero Emission Vehicles and ZEV mandates in British Columbia and Québec. British Columbia's Clean Fuel Standard covers the entire sector and it was strengthened under the CleanBC plan in 2019, with expanded coverage of aviation and marine fuels.

A2.1.2.1.3 Electricity Generation

As Canada moves towards a low-carbon future, the electricity sector will play an increasingly important role in decarbonizing the economy. Most, if not all, deep decarbonisation pathways involve a clean electricity grid and electrification of other economic sectors. As about 84% of the utility electricity supply in Canada is generated from non-GHG emitting sources, the electricity sector comprised only 10% of total Canadian GHG emissions in 2017. Since 2005, electricity sector emissions have fallen an average of 4% per year (mainly due to Ontario's coal phase-out), the fastest of any sector in Canada. The mix of sources of energy used to generate power vary considerably across the country, depending on regional features such as the availability of renewable energy resources like hydropower, transmission interconnections to other provinces and the United States, and access to natural gas. Several provinces rely almost exclusively on hydropower, while other jurisdictions have highly diversified mixes of power that combine non-emitting power from renewables and nuclear with fossil fuel generation. A few provinces rely primarily on fossil fuels such as coal, natural gas, and refined petroleum products.

Several Canadian provinces have achieved nearly 100% non-emitting grids by 2017. Québec, Manitoba, and British Columbia generate over 99% of their electricity from hydro and other renewables and are expected to continue to develop new renewable resources in the future. Prince Edward Island has reduced thermal generation to near zero, with 98% of on-island generation coming from its wind resources. The Yukon has also substantially reduced its reliance on diesel and now generates 92% of its electricity from renewable sources.

Finally, growing use of on-site cogeneration to meet industrial electricity and steam demands, has reduced utility demands and has further reduced electricity sector emissions. Cogeneration is the simultaneous generation of electricity and heat and/or steam that can be then used in industrial processes such as in situ oil sands extraction. As a result of increasing use of cogeneration, emissions for electricity production are shifted from the utility electricity sector to the oil and gas sector. Moreover, the combined production of power and steam is more efficient than their separate production due to the capturing of waste heat and steam. As a result, the general economy-wide impact of shifting from utility natural gas-fired electricity generation (or other fossil fuel sources) to industrial cogeneration using natural gas is a reduction in GHG emissions. In the particular context of Alberta's coal-based electricity grid, these reductions can be substantial. For example, the Suncor Base Plant cogeneration facility was added to the projections this year which will replace old industrial petroleum coke boilers and displace higher-emitting utility generation.

The recent downward trend in emissions from the electricity sector is expected to continue over the next decade due to various federal and provincial governmental initiatives. Emissions in the electricity sector fell by 45 Mt from 2005 to 2017 and are projected to further decrease by 50 Mt by 2030, for a total decrease of 95 Mt over the period while total generation increases. Table A2.5 outlines the decline in projected emissions alongside the expected increase in electricity generation from 2005 through 2030.

Table A2.5: Utility Electricity Sector: Emissions and Drivers

	Historical				Projected		Change 2005 to 2030
	2005	2010	2015	2017	2020	2030	
Emissions (Mt CO2e)	119	97	81	74	52	24	-95
Generation (Terawatt Hours)	554	542	580	584	580	595	41

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

Federal regulations to reduce CO_2 emissions from coal-fired electricity came into effect on July 1, 2015. The regulations apply a stringent performance standard to new coal-fired electricity generation units and those coal-fired units that have reached the end of their economic life. The regulations will facilitate a permanent transition towards lower or non-emitting types of generation such as high-efficiency natural gas and renewable energy. With these regulations, Canada became the first major coal user to effectively ban construction of conventional coal-fired electricity generation units. To further its commitment to eliminate coal-fired electricity, the federal government accelerated the coal-phase out to 2030 by introducing amendments to the regulations.

As such, coal generation is expected to fall close to zero by 2030. Saskatchewan's carbon capture and storage Boundary Dam 3 plant is the only unit currently expected to not be affected by the regulation, as it would operate below the performance standard limit of 420 tCO_2/GWh. There is, however, the possibility that some jurisdictions seek equivalency agreements with respect to the federal coal regulations which could lead to other coal-fired plants operating in 2030. At present, while there are such agreements in place, none currently cover the year 2030. This should not have an impact on planned system-wide emissions reductions as any equivalency agreement must achieve the same or better emissions outcomes as compared to a scenario with the federal regulations in place. Natural gas generation is expected to increase to replace coal and nuclear generation, as well as to support increasing use of intermittent sources of generation such as wind.

In addition, several provinces have introduced significant measures to move away from fossil fuel electricity generation and towards cleaner sources of power that contribute to the decline in emissions in the electricity sector. Nova Scotia aims to decrease emissions in its electricity sector through a declining cap on emissions and a renewable portfolio standard that will require 40% of electricity sales to come from renewable sources by 2020. Saskatchewan aims to have between 40% and 50% of its electricity generation capacity to be from non-emitting sources by 2030. Alberta will be adding significant intermittent renewable capacity to its grid through the first three rounds of its Renewable Electricity Program. Newfoundland and Labrador is constructing a new large hydro dam (Muskrat Falls) and an underwater transmission link between Labrador and Newfoundland Island to replace ageing, high-emitting heavy fuel oil generation on the Island with renewable power.

Consequently, the proportion of utility electricity generation coming from renewable sources is projected to increase between 2017 and 2030. Hydropower generation is expected to increase in most Canadian provinces and territories, bringing hydropower from 62% to 66% of utility electricity generated in Canada. Non-hydro renewables such as wind, solar, biomass and waste generation are expected to continue to grow at over 5% per year between 2017 and 2030 and are projected to account for nearly 12% of total utility generation by 2030. Nuclear power, however, is expected to decline by 26% over the same time frame, as Ontario reduces its nuclear capacity between 2020 and 2030 with the retirement of several ageing units.

Overall, emissions from coal-fired generation are projected to decline by 102 Mt over the 2005 to 2030 time period. Emissions from refined petroleum products such as diesel and fuel oils are expected to fall by over 11 Mt. Emissions from natural gas are expected to increase by about 13 Mt over the period in the electricity sector, as natural gas replaces coal in some provinces, helps meet growing electricity demand, and supports the integration of higher levels of intermittent renewables.

Table A2.6: Utility Electricity Sector Emissions by Fuel Type (Mt CO2 eq) from 2005 to 2030

	Historical				Projected		Change 2005 to 2030
	2005	2010	2015	2017	2020	2030	
Coal	98	79	62	57	24	0	-98
Refined Petroleum Products	11	5	5	5	3	0	-11
Natural Gas	10	13	13	12	25	23	13
Biomass	0	0	0	0	0	0	0
Total	**119**	**97**	**81**	**74**	**52**	**24**	**-95**

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

A2.1.2.1.4 Heavy Industry

The heavy industry sector includes metal and non-metal mining activities, smelting and refining, and the production and processing of industrial goods such as chemicals, fertilizers, aluminum, pulp and paper, iron and steel and cement.

Emissions from the heavy industry sector decreased by 14 Mt between 2005 and 2017, but are projected to increase by 12 Mt between 2017 and 2030 due to increased production in some subsectors. Emissions are estimated to have been at their lowest point in 2009 following a decline in pulp and paper, iron and steel, and smelting and refining output, but then recovered somewhat with increased chemical and fertilizer production.

Table A2.7: Heavy Industry: Emissions and Drivers

	Historical				Projected		Change 2005 to 2030
	2005	2010	2015	2017	2020	2030	
Emissions (Mt CO2e)	87	74	77	73	77	84	-2
Gross Output of Heavy Industry (1997 $billions)	145	121	140	141	149	176	31

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

On average, emissions generated by heavy industry subsectors are projected to be 2% less than 2005 levels by 2030, largely due to production losses during the economic downturn of 2009. Modest production growth in successive years has been offset by continued reduction of emissions intensities, in response to some government funding for energy and emission reduction projects.

Over the 2017 to 2030 period GHG emissions from a number of subsectors are projected to increase. For example, emissions are projected to grow 31% for mining, 31% for iron and steel, and 22% for chemicals and fertilizers. This reflects expected increases in production, while the energy efficiency of the subsectors increases more slowly.

Table A2.8: Heavy Industries' Emissions by Subsector (Mt CO2 eq) from 2005 to 2030

	Historical				Projected	
	2005	2010	2015	2017	2020	2030
Mining	7	8	8	7	7	9
Smelting and Refining (Non-ferrous metals)	14	11	10	11	11	12
Pulp and Paper	9	7	7	7	7	6
Iron and Steel	16	14	15	16	17	20
Cement	13	10	10	11	11	11
Lime and Gypsum	3	3	2	2	2	2
Chemicals and Fertilizers	24	22	25	20	22	24
Total	**87**	**74**	**77**	**73**	**77**	**84**

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

A2.1.2.1.5 Buildings

Emissions in Canada's commercial and residential buildings (excluding indirect emissions from electricity) decreased by 1 Mt between 2005 and 2017. Between 2005 and 2017, buildings have accounted for about 12% of Canada's GHG emissions in any given year. Despite a growing population and increased housing stock and commercial/institutional building stock, energy efficiency improvements are projected to help emissions decline by 8 Mt from 2017 to 2030, a 8.8% decline over the period. This highlights the decreasing emissions intensities in the average building due to increasing energy costs (including the impact of carbon pricing) being managed with better technologies and practices.

Residential

As shown in Table A2.9, GHG emissions from the residential buildings (e.g., houses, apartments and other dwellings) declined by 6.8% between 2005 and 2017, and are projected to decline by a further 7.9% between 2017 and 2030. This is despite an expected 18% increase in the number of Canadian households (a key driver of residential emissions growth) between 2017 and 2030. In addition, federal and provincial measures aimed at increasing the energy efficiency of residential buildings, such as building code regulations, rebates for energy efficiency improvements and voluntary housing energy efficiency standards help to improve efficiencies in this subsector over time.

Table A2.9: Residential Subsector: Emissions and Drivers

	Historical				Projected		Change 2005 to 2030
	2005	2010	2015	2017	2020	2030	
Emissions (Mt CO_2e)	46	43	45	43	42	39	-6
Households (millions)	12	13	14	14	15	17	5

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

Commercial

As shown in Table A2.10, emissions in the commercial subsector increased by 4.8% between 2005 and 2017, while commercial floor space (the principal driver of emissions from this subsector) increased by 15.1% during the same period. A strengthening of building energy codes, an increased commitment to benchmark energy use, and undertaking of energy-related retrofits thus constrained the impact of the growth in floor space on GHG emissions. Between 2017 and 2030, continued efficiency improvements and the phase down of and bulk import ban on HFCs used in refrigeration and air conditioning results in emissions decreasing by 9.9%, despite continued growth in floor space. As HFCs have an average global warming potential that is up to 1900 times more potent than CO_2, decreasing HFC consumption has a significant impact on projected emissions.

Table A2.10: Commercial Subsector: Emissions and Drivers

	Historical				Projected		Change 2005 to 2030
	2005	2010	2015	2017	2020	2030	
Emissions (Mt CO_2e)	40	39	41	42	41	38	-2
Floor space (millions m^2)	654	714	747	753	767	848	194

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

A2.1.2.1.6 Agriculture

The majority of GHG emissions from agriculture are not due to fossil fuel burning but are due to biological processes in animal and crop production. Most of the GHGs emitted in the agricultural sector (on a CO2 equivalency basis) are methane and nitrous oxide with a smaller amount of carbon emissions from on-farm fuel combustion.

Canadian agricultural GHG emissions have been relatively stable at approximately 72 Mt CO2 eq since 2005 and are projected to slightly increase over the next decade to be at 76 Mt in 2030, 4 Mt more than the 2005 levels. The sources of those emissions show a compositional shift over the historical and projected periods. Increased emissions from crop production due to an increased use of fertilizers are being offset by decreased emissions in livestock production due to decreased cattle herds. Emissions from on-farm fuel use are expected to keep with the historical trend of approximately 12 Mt per year.

Table A2.11: Agriculture Sector Emissions by Subsector (Mt CO_2 eq) from 2005 to 2030

	Historical				Projected		Change 2005 to 2030
	2005	2010	2015	2017	2020	2030	
On-Farm Fuel Use	12	13	13	12	12	12	0
Crop Production	16	18	23	24	25	26	10
Animal Production	44	37	35	36	36	37	-7
Total	**72**	**68**	**71**	**72**	**74**	**76**	**4**

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

In addition to crops, animals, and fuel combustion, changes in land use patterns also play an important role in the GHG impact of the agricultural sector. Over the last decade, agricultural land in Canada has been a net carbon sink, reducing the total GHG impact of the sector. Emissions and removals (sequestration) of carbon from agricultural soils due to changes in land management practices and land-use are accounted for separately in the LULUCF sector.

A2.1.2.1.7 Waste and Others

From 2005 to 2017, GHG emissions from municipal solid waste landfills declined, as a result of provincial government measures aimed at capturing landfill gas as well as organic waste diversion. Between 2017 and 2030, emissions are expected to remain stable despite projected population growth.

Non-emissions-intensive industrial subsectors included in the Waste and Others sector represent a wide variety of operations, and include light manufacturing (e.g., food and beverage, and electronics), construction, and the forestry and logging service industry. Emissions from these various subsectors declined after the 2009 economic downturn but are projected to increase slightly over the 2017 to 2030 timeframe driven by projected economic growth. Carbon pricing is currently the main policy measure that helps contain the growth in emissions from the light manufacturing, construction, and forest resources sector.

Table A2.12: Waste and Others Emissions by Subsector (Mt CO_2 eq) from 2005 to 2030

	Historical				Projected		Change 2005 to 2030
	2005	2010	2015	2017	2020	2030	
Waste	20	18	19	19	19	19	-1
Coal Production	2	3	2	2	2	2	0
Light Manufacturing, Construction & Forest Resources	24	22	21	21	22	24	0
Total	**47**	**43**	**42**	**42**	**43**	**45**	**-1**

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

A2.1.2.1.8 Foreign Passenger and Foreign Freight

Emissions from Foreign Passenger and Foreign Freight sectors are not included in the national total consistent with UNFCCC reporting guidelines.

Emissions from the Foreign Passenger and Foreign Freight sectors comprise total Canadian fuel sold to foreign registered watercraft and aircraft. Emissions increased by 1 Mt between 2005 and 2017, and are expected to increase 13% between 2017 and 2030 as the number of foreign transportation vehicles and number of kilometers traveled increases. These projections account for energy efficiency improvements, including voluntary emissions reduction agreements with the aviation and rail sectors.

Table A2.13: Fuel Sold to Ships Emissions by Subsector (Mt CO_2 eq) from 2005 to 2030

	Historical				Projected		Change 2005 to 2030
	2005	2010	2015	2017	2020	2030	
Foreign Freight	5	4	2	3	3	3	-2
Foreign Passenger	9	8	11	11	12	13	5
Total	**13**	**12**	**13**	**14**	**15**	**16**	**3**

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

A2.1.2.2 Emissions by Gas

CO_2 emissions decreased by 1% between 2005 and 2017, and are projected to decline by about 5% between 2017 and 2030. On a CO_2 eq basis, CO_2 represented 79% of total Canadian GHG emissions in 2005. By 2030 this share is expected to increase slightly to 81%.

Between 2005 and 2017, CO_2 emissions increased in the oil and gas, transportation and agriculture sectors. Between 2017 and 2030, CO_2 emissions are projected to increase in the oil and gas, heavy industry, and waste and other sectors, while CO_2 emissions in other sectors are projected to decrease with the exception of agriculture where emissions are projected to be constant.

Between 2005 and 2017, methane (CH_4) emissions decreased by 12%, mostly due to declines in emissions from the agriculture and oil and gas sectors. Between 2017 and 2030, CH_4 emissions are projected to decrease further, with government regulations expected to drive a projected 33% decrease of methane emissions in the oil and gas sector. That said, the upstream oil and gas sector is projected to remain the largest industrial source of methane in Canada even when taking into account the impact of the regulations.

Nitrous oxide (N_2O) emissions increased by 1 Mt between 2005 and 2017 and are projected to increase by 2 Mt of CO_2 eq between 2017 and 2030. N_2O emissions arise primarily from the agriculture sector.

Hydrofluorocarbons (HFCs) have been increasingly used in the last decade in refrigeration and air conditioning systems as an alternative to ozone damaging hydrochlorofluorocarbons (HCFCs), which lead to 2017 emissions being 8 Mt higher than in 2005. HCFCs are being phased out under the Montreal

Protocol and the Kigali amendment to that agreement in 2016 added the phase down of the use and production of HFCs. As a result, emissions of HFCs are projected to peak in 2020 at 13.9 Mt of CO_2 eq before declining to 10.4 Mt of CO_2 eq in 2030.

Perfluorocarbons (PFCs), sulphur-hexafluoride (SF_6), and nitrogen trifluoride (NF_3) are projected to decrease substantially over the projection period. The main releases of these gases into the environment occur during the manufacture of semi-conductors, refrigeration equipment and the production of aluminium as well as other industrial processes such as in the magnesium industry. Reductions are anticipated from voluntary measures in the aluminum industry, electricity transmission and other sectors.

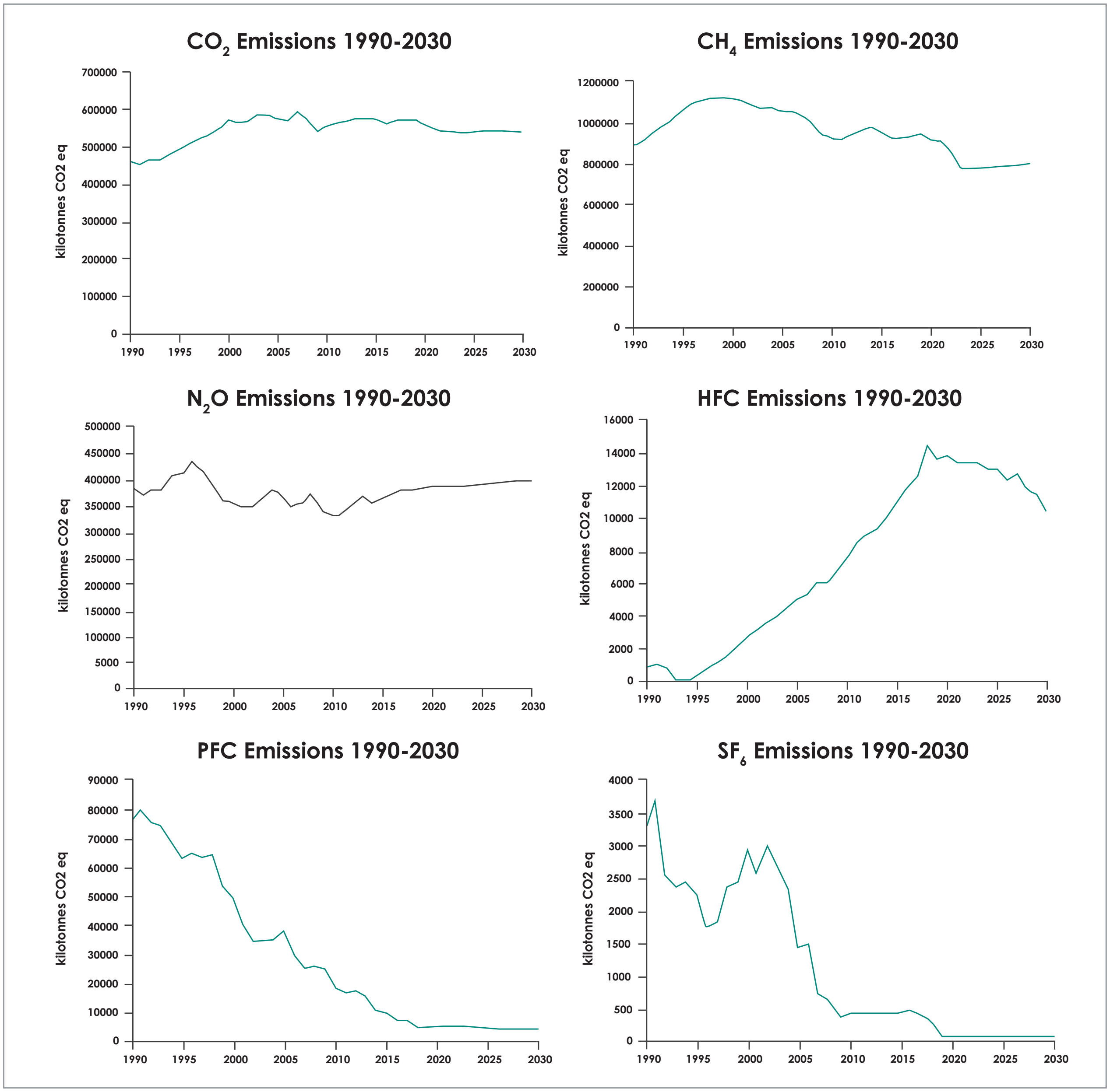

Figure A2.4: Total Canadian Emissions by Gas under WM Scenario, 1990–2030: CO_2, CH_4, N_2O, HFC, PFC, SF_6

A2.1.2.3 Emissions by Gas and Economic Sector

The following tables summarize total GHG projections by sector and by gas under the WM Scenario and illustrate how the projected trends vary by gas and by economic sector.

Table A2.14: CO_2 Emissions Projections by Economic Sector under WM Scenario (Mt CO_2 eq)

	Historical							Projected	
	1990	1995	2000	2005	2010	2015	2017	2020	2030
Oil and Gas	70	82	102	110	117	146	152	164	184
Electricity	94	97	128	118	96	80	74	51	23
Transportation	117	117	138	154	162	166	167	163	149
Heavy Industry	73	79	83	77	70	74	70	75	83
Buildings	68	73	78	79	73	74	72	69	64
Agriculture	12	15	15	14	15	15	15	15	15
Waste & Others	30	29	27	25	23	22	22	22	24
Total	**463**	**494**	**572**	**577**	**556**	**577**	**571**	**560**	**542**

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

Table A2.15: CH_4 Emissions Projections by Economic Sector under WM Scenario (Mt CO_2 eq)

	Historical							Projected	
	1990	1995	2000	2005	2010	2015	2017	2020	2030
Oil and Gas	36	49	55	47	41	45	42	41	28
Electricity	<0.1	0	0	0	0	0	0	0	0
Transportation	2	2	1	1	1	1	1	1	1
Heavy Industry	0	0	0	0	0	0	0	0	0
Buildings	5	5	4	3	3	3	3	3	3
Agriculture	25	30	31	35	29	28	28	28	29
Waste & Others	21	21	21	21	19	19	19	19	20
Total	**89**	**106**	**113**	**106**	**93**	**96**	**93**	**92**	**80**

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

Table A2.16: N_2O Emissions Projections by Economic Sector under WM Scenario (Mt CO_2 eq)

	Historical							Projected	
	1990	1995	2000	2005	2010	2015	2017	2020	2030
Oil and Gas	0.3	0.4	0.5	0.6	0.6	0.8	0.9	1.0	1.1
Electricity	0.5	0.6	0.7	0.7	0.6	0.5	0.5	0.4	0.2
Transportation	3.8	4.2	5.8	5.8	4.3	3.3	3.3	3.3	3.1
Heavy Industry	11.7	11.8	2.6	4.3	1.5	1.6	1.4	0.8	0.9
Buildings	1.1	1.2	1.4	1.2	1.1	1.2	1.4	1.4	1.4
Agriculture	20.8	22.6	24.0	23.6	24.3	27.9	29.4	30.9	31.9
Waste & Others	0.6	0.7	0.9	0.9	1.0	1.1	1.1	1.2	1.3
Total	**38.9**	**41.4**	**35.9**	**37.2**	**33.4**	**36.5**	**38.0**	**38.9**	**40.0**

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

Table A2.17: HFC Emissions Projections by Economic Sector under WM Scenario (Mt CO_2 eq)

	Historical							Projected	
	1990	1995	2000	2005	2010	2015	2017	2020	2030
Oil and Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electricity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transportation	0.0	0.1	1.1	1.9	2.6	3.3	3.6	3.2	0.7
Heavy Industry	1.0	0.0	0.0	0.0	0.5	0.6	0.3	0.3	0.2
Buildings	0.0	0.3	1.5	2.8	4.4	6.8	8.3	10.0	9.2
Agriculture	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Waste & Others	0.0	0.0	0.1	0.4	0.3	0.4	0.3	0.4	0.3
Total	**1.0**	**0.5**	**2.8**	**5.1**	**7.8**	**11.0**	**12.6**	**13.9**	**10.4**

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

Table A2.18: PFC Emissions Projections by Economic Sector under WM Scenario (Mt CO_2 eq)

	Historical							Projected	
	1990	1995	2000	2005	2010	2015	2017	2020	2030
Oil and Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electricity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transportation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heavy Industry	7.6	6.3	4.9	3.8	1.8	1.0	0.7	0.5	0.4
Buildings	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agriculture	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Waste & Others	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**7.6**	**6.3**	**5.0**	**3.8**	**1.9**	**1.0**	**0.7**	**0.5**	**0.4**

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

Table A2.19: SF_6 Emissions Projections by Economic Sector under WM Scenario (Mt CO_2 eq)

	Historical							Projected	
	1990	1995	2000	2005	2010	2015	2017	2020	2030
Oil and Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electricity	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.0
Transportation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heavy Industry	3.0	2.1	2.7	1.2	0.3	0.3	0.3	0.0	0.0
Buildings	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agriculture	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Waste & Others	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**3.2**	**2.3**	**2.9**	**1.4**	**0.5**	**0.5**	**0.4**	**0.1**	**0.1**

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2019.

A2.1.3 Technology Case

The TC includes all policies and measures in the WM and WAM scenarios. The scenario also includes the following trends (see Figure A2.5 to Figure A2.8):

- High adoption of air and ground source heat pumps in the buildings sector
    - 40% of new heating devices in commercial buildings are heat pumps by 2030, increasing to 70% by 2040
    - 35% of new heating devices in residential buildings are heat pumps by 2030, increasing more than 60% by 2040
- High electric vehicle (EV) adoption
    - Sales are 30% EV by 2030, and ~75% by 2040[30]
- Improved SAGD oil sands extraction
    - A five-fold efficiency improvement by 2040 on new facilities, leading to more than a doubling of average efficiency across the sector
- Adoption of new inert anodes for aluminum manufacturing
    - Phased in beginning in 2025 leading to full adoption by 2050.
- Reduced renewable electricity generation capital costs
    - 38% decline in wind overnight capital costs by 2040 compared to 2018
    - 64% decline in solar overnight capital costs by 2040 compared to 2018

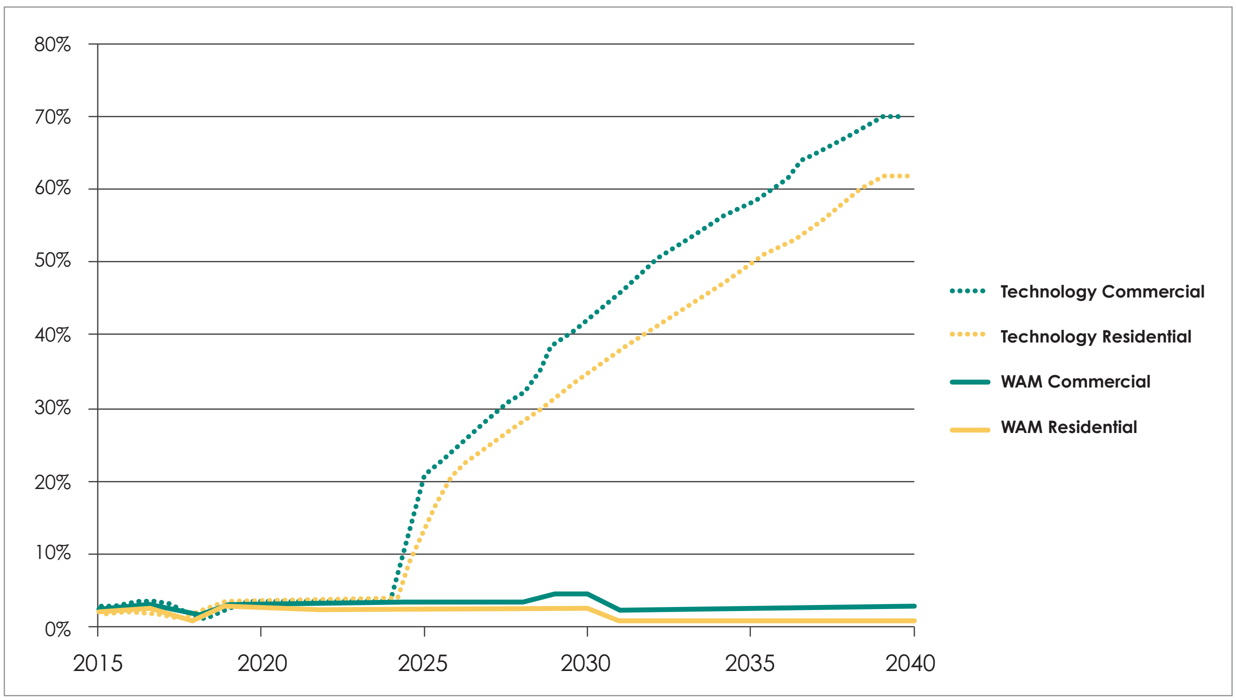

Figure A2.5: Share of heat pumps in new building heating equipment sales, Technology and WAM Scenarios (2015-2040)

30 These projected sales target only cover electric vehicles. The government of Canada has set Canada-wide targets where all zero-emission vehicles will represent 30% of sales by 2030, and 100% by 2040.

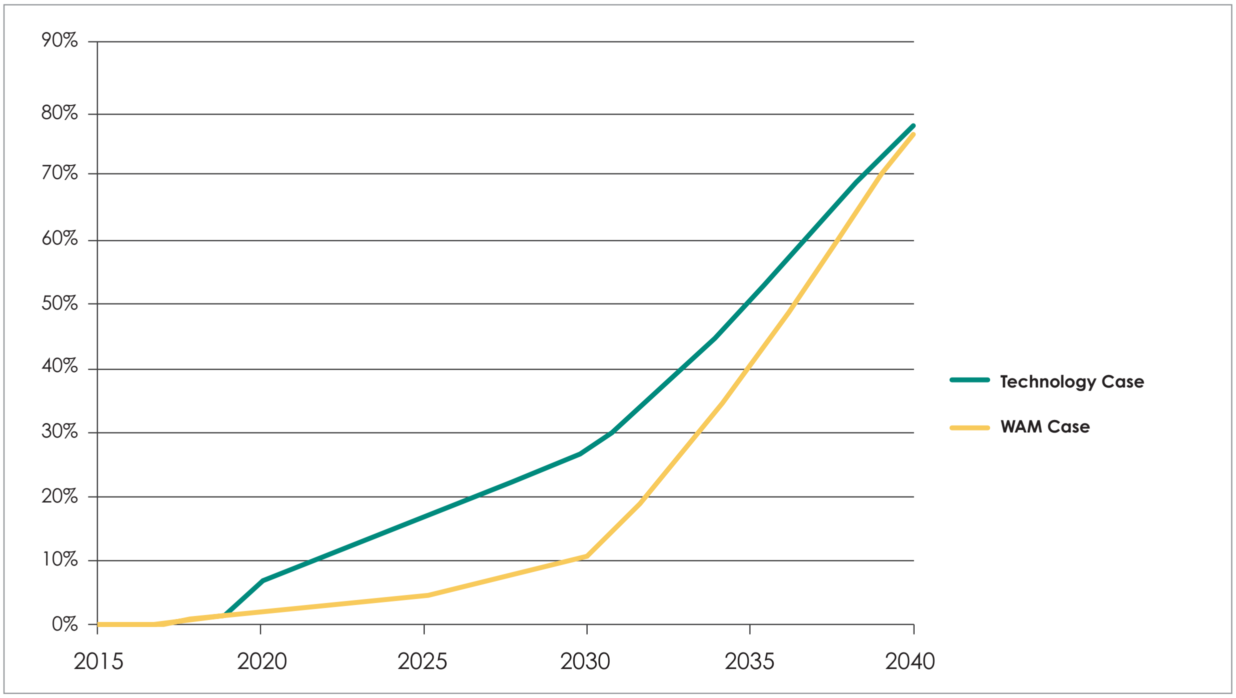

Figure A2.6: Share of EVs in new passenger vehicle sales, Technology and WAM Scenarios (2015-2040)

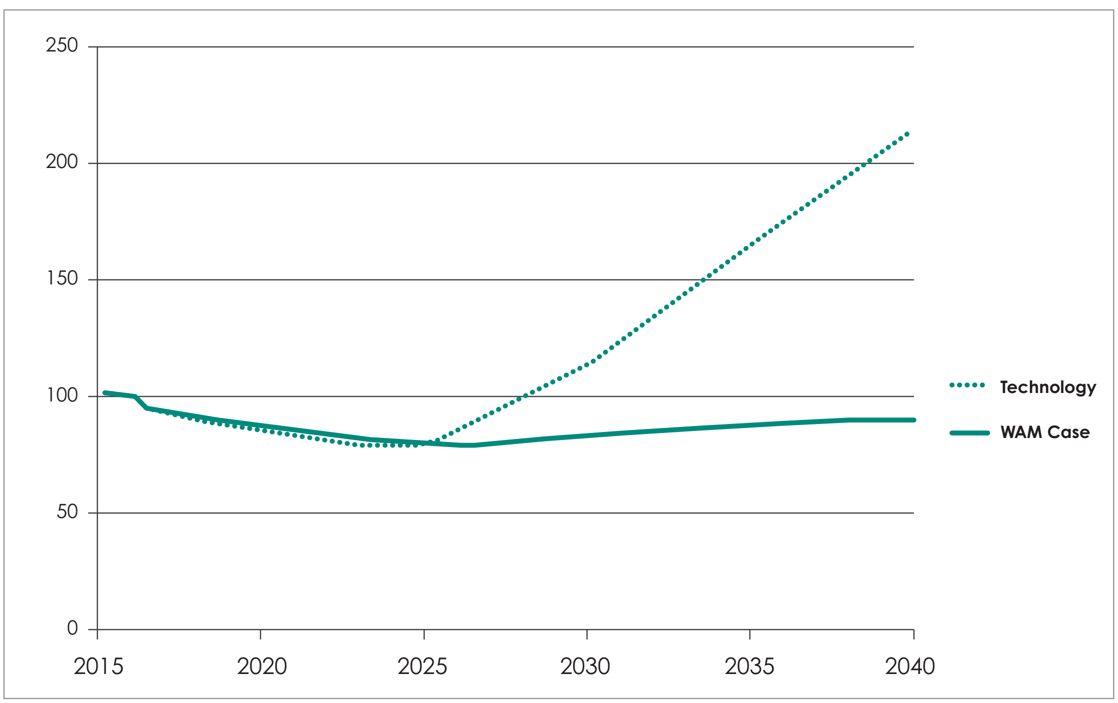

Figure A2.7: Average efficiency (indexed to 2015) of SAGD Oil Sands Extraction, Technology and WAM Scenarios (2015-2040)

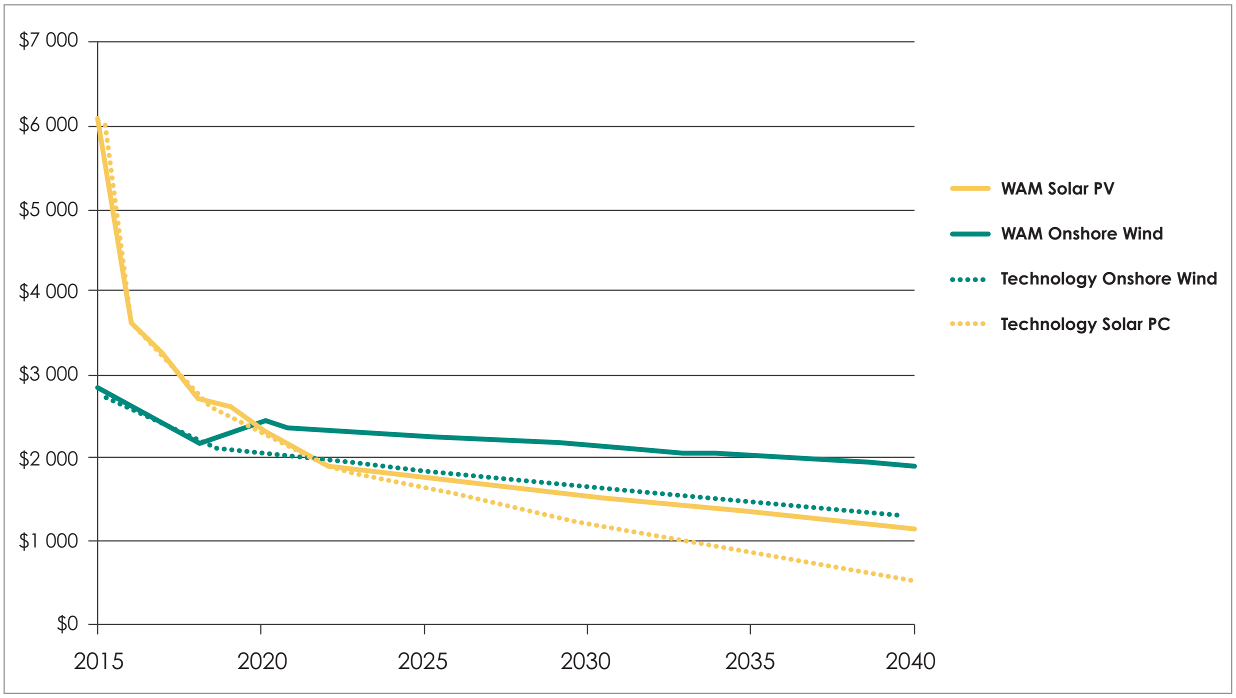

Figure A2.8: Overnight capital costs (2017 CAD$/kW) for onshore wind and solar PV, Technology and WM Scenarios (2015-2040)

A2.1.4 Air Pollutant Emissions Projections

The following section provides background information on what causes the growth or decline of projected air pollutant emissions in Canada. Table A2.20 through Table A2.29 provide detailed national emissions by economic sector and pollutant for select historical and projection years.

Sulphur Oxides (SOx)

In Canada, sulphur oxides (SOx) emissions are driven mostly by the production of aluminum and other nonferrous metals, coal-fired electricity generation, and natural gas processing. SOx emissions have been declining significantly over the recent past and are expected to drop further over the projection period – with reductions primarily due to the coal phase-out for electricity generation and regulations on low sulphur fuels.

Table A2.20: Sulphur Oxides Emissions in Kilotonnes

	Historical			Projected	
	2005	2010	2017	2020	2030
Agriculture	5	8	7	6	7
Buildings	56	18	8	8	7
Electricity and Steam	522	334	246	123	2
Heavy Industry	929	521	405	379	405
Oil and Gas	462	341	259	271	296
Transportation	148	115	17	17	18
Waste and Others	34	18	10	10	11
Total	**2156**	**1355**	**952**	**814**	**746**

Nitrogen Oxides (NOx)

Emissions of nitrogen oxides (NOx) are mostly attributed to diesel use in transportation, natural gas production, and utility electric generation. Emission levels have decreased at a steady rate since 2005 and are expected to continue to decline throughout the projection period, due in part to regulations in the transportation sector, natural gas production and electricity generation.

Table A2.21: Nitrogen Oxides Emissions in Kilotonnes

	Historical			Projected	
	2005	2010	2017	2020	2030
Agriculture	131	117	65	48	33
Buildings	101	82	83	79	72
Electricity and Steam	254	235	146	74	15
Heavy Industry	207	141	140	141	150
Oil and Gas	442	471	488	446	313
Transportation	1182	973	788	744	733
Waste and Others	144	107	69	60	54
Total	**2460**	**2125**	**1779**	**1591**	**1370**

Volatile Organic Compounds (VOCs)

The increase in projected volatile organic compounds (VOCs) emissions is primarily driven by steady year over year growth of fugitive VOC emissions in oil production. Between 2020 to 2023, when the regulations for reducing methane and VOC emissions in the upstream oil and gas sector will be fully in place, VOC emissions are projected to bottom out, but are then expected to increase slowly until 2030 and are linked to higher expected light oil production in the oil and gas sector.

Table A2.22: Volatile Organic Compounds Emissions in Kilotonnes

	Historical			Projected	
	2005	2010	2017	2020	2030
Agriculture	179	163	152	150	148
Buildings	513	467	459	434	425
Electricity and Steam	3	2	1	1	0
Heavy Industry	151	99	99	97	113
Oil and Gas	676	648	684	767	814
Transportation	569	450	252	241	225
Waste and Others	248	191	160	146	165
Total	**2340**	**2020**	**1808**	**1835**	**1891**

Particulate Matter (PM)

The majority of emissions of particulate matter (TPM, PM10 and PM2.5) comes from open sources. Open sources include emissions from construction, crop production, road dust and forest fires and account for 97% of total PM emissions.

Other significant sources of PM emissions are utility generation, production of non-ferrous metals and iron ore pelletizing (non-open sources). Current policies and regulations such as Base Level Industrial Emission Requirements (BLIERs) and Air Quality Management System (AQMS) are leading to decreasing particulate matter emissions excluding open sources. However, total emissions of PM are expected to grow: increases in emissions from open sources have and will continue to more than offset the reductions from the targeted industries. Projected increase in PM emissions from open sources are driven by growth in transportation, construction activity and crop farming.

Table A2.23: Total Particulate Matter Emissions in Kilotonnes

	Historical			Projected	
	2005	2010	2017	2020	2030
Agriculture	50	47	42	41	40
Buildings	253	253	262	251	233
Electricity and Steam	35	22	16	5	0
Heavy Industry	157	113	100	107	128
Oil and Gas	21	16	26	31	33
Transportation	67	57	36	36	37
Waste and Others	157	188	202	203	218
Total Without Open Sources	**741**	**697**	**684**	**672**	**689**
Total With Open Sources	**18476**	**21120**	**23531**	**24684**	**28195**

Table A2.24: Particulate Matter 10 Emissions in Kilotonnes

	Historical			Projected	
	2005	2010	2017	2020	2030
Agriculture	24	22	15	14	12
Buildings	209	205	204	194	176
Electricity and Steam	15	10	7	2	0
Heavy Industry	81	56	48	51	61
Oil and Gas	17	13	18	21	23
Transportation	66	56	36	34	35
Waste and Others	60	63	72	72	76
Total Without Open Sources	**473**	**424**	**401**	**388**	**383**
Total With Open Sources	**5980**	**6726**	**7499**	**7824**	**8830**

Table A2.25: Particulate Matter 2.5 Emissions in Kilotonnes

	Historical			Projected	
	2005	2010	2017	2020	2030
Agriculture	15	13	7	5	4
Buildings	197	192	188	178	160
Electricity and Steam	9	6	3	1	0
Heavy Industry	57	37	32	34	40
Oil and Gas	13	10	13	15	16
Transportation	53	44	24	23	23
Waste and Others	31	21	19	19	21
Total Without Open Sources	**376**	**322**	**286**	**275**	**265**
Total With Open Sources	**1496**	**1566**	**1674**	**1723**	**1889**

Black Carbon

The main sources of black carbon emissions are combustion of diesel and biomass fuel. In 2016, diesel fuel sources accounted for 48% of total black carbon emissions, while biomass fuel sources contributed to 33%. The projected downward trend in black carbon emissions is driven mostly by reductions in consumption of diesel and biomass and more efficient pollution-control technologies – in particular, on-road and off-road transportation for diesel, and use of biomass for heating in buildings.

Table A2.26: Black Carbon Emissions in Kilotonnes

	Historical			Projected	
	2005	2010	2017	2020	2030
Agriculture	n.a.	n.a.	3	2	1
Buildings	n.a.	n.a.	13	12	11
Electricity and Steam	n.a.	n.a.	0	0	0
Heavy Industry	n.a.	n.a.	2	1	1
Oil and Gas	n.a.	n.a.	3	3	4
Transportation	n.a.	n.a.	12	12	12
Waste and Others	n.a.	n.a.	3	2	1
Total	**n.a.**	**n.a.**	**36**	**33**	**30**

*Black carbon emissions begin in 2013

Carbon Monoxide (CO)

Carbon Monoxide (CO) emissions have consistently trended downwards starting from 2005 and are projected to continue declining throughout the projection period. The projected reduction in carbon monoxide emissions is driven by a reduction in passenger transportation emissions, specifically the emissions from light duty vehicles (LDV).

Table A2.27: Carbon Monoxide Emissions in Kilotonnes

	Historical			Projected	
	2005	2010	2017	2020	2030
Agriculture	375	315	182	182	183
Buildings	1252	1251	1246	1176	1054
Electricity and Steam	52	44	42	30	14
Heavy Industry	621	622	679	709	849
Oil and Gas	497	526	554	576	558
Transportation	4348	3389	2554	2260	2275
Waste and Others	826	523	401	410	412
Total	**7970**	**6670**	**5657**	**5342**	**5346**

Mercury

Emissions of mercury have dropped significantly since 2007, mainly driven by reductions in smelting, refining, and utility electricity generation. From 2011 onward and throughout the projection period, total mercury emissions decrease at a slower rate and remain relatively flat. Major sectors contributing to mercury emissions are electricity generation, iron and steel production and waste incineration.

Table A2.28: Mercury Emissions in Kilograms

	Historical			Projected	
	2005	2010	2017	2020	2030
Agriculture	10	16	14	14	14
Buildings	976	634	345	340	344
Electricity and Steam	2167	1582	601	288	51
Heavy Industry	3228	1821	1405	1411	1696
Oil and Gas	194	228	126	134	150
Transportation	102	82	53	50	54
Waste and Others	1014	639	482	506	576
Total	**7691**	**5002**	**3026**	**2742**	**2886**

Ammonia

Historically ammonia emissions have been relatively steady from 2005 to 2017, staying below 500 kt each year. Starting in 2018 emissions are expected to increase gradually –driven by a steady increase in animal and crop production emissions, and increased expected use of nitrogen based fertilizer. Animal and crop production were responsible for approximately 94% of total projected ammonia emissions in 2017. The third largest contributor to the ammonia emissions was fertilizer production at 1.6% of total projected ammonia emissions.

Table A2.29: Ammonia Emissions in Kilotonnes

	Historical			Projected	
	2005	2010	2017	2020	2030
Agriculture	454	423	446	479	606
Buildings	8	7	7	7	7
Electricity and Steam	1	1	0	0	0
Heavy Industry	14	12	11	12	14
Oil and Gas	2	2	3	3	3
Transportation	11	9	8	7	6
Waste and Others	4	2	2	2	2
Total	**495**	**455**	**476**	**510**	**639**

A2.2 Decomposition of Projected Change in Canada's GHG Emissions Projections in the WM Scenario

The following explores how different factors contribute to trends in historical and projected emissions through a decomposition analysis of Canada's GHG emissions for the 2005-2030 period under the WM scenario (see Table 5.1).

- The **Activity Effect** measures the impact of economic growth (estimated to be 56% over the 2005-2030 period). On its own, this growth would have been expected to lead to 333 Mt of additional GHG emissions in 2030 (or 13.3 Mt per year).
- The **Carbon Intensity Effect** measures changes in the carbon emission coefficient of energy. The shift to cleaner fuels such as the replacement of coal-fired electricity with cleaner sources, as well as measures to reduce fugitive and process emissions, are projected to have a significant impact, reducing emissions by 121 Mt in 2030 (or 4.8 Mt per year).
- The **Energy Efficiency Effect** measures changes in energy efficiency at the subsector level. The projections indicate that the uptake of energy efficient technologies—induced by policies, consumer responses to energy prices, and stock turnover— reduces emissions by 269 Mt in 2030 (or 10.8 Mt per year).

The decomposition shows that over the period 2005-2030, there is a decoupling of economic growth and combustion emissions: upward pressure on GHG emission projections arising from GDP growth are slightly more than offset by the switch to cleaner and more efficient energy use.

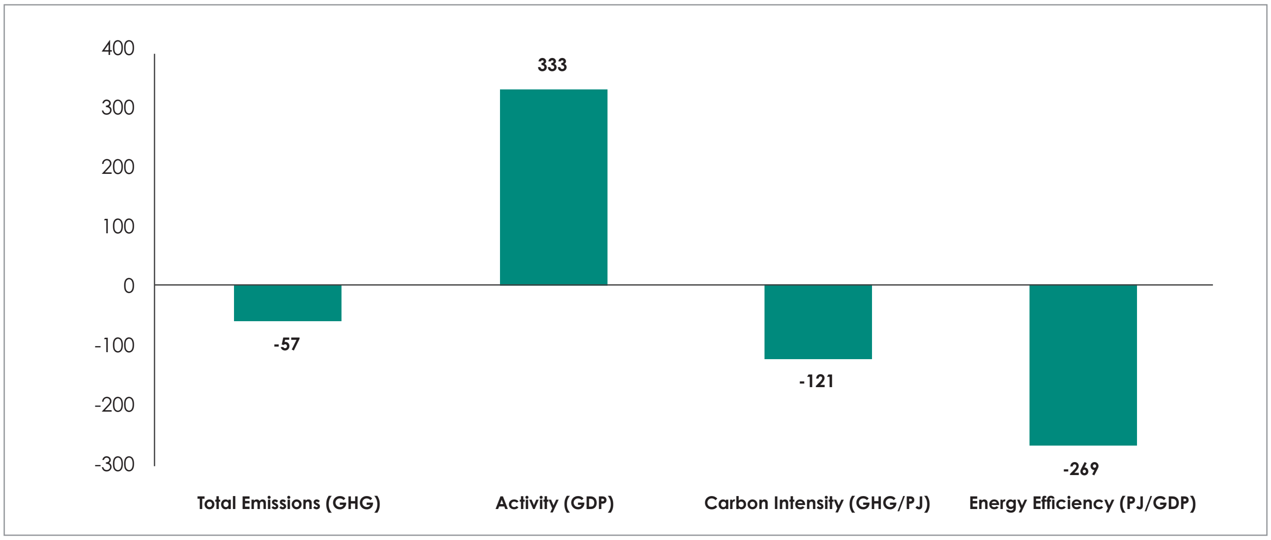

Figure A2.9: Decomposition of Emissions Growth 2005-2030 under WM scenario (excluding Land Use, Land-Use Change and Forestry)

A2.3 Baseline Data and Assumptions

Many factors influence the future trends of Canada's GHG emissions. These key factors include economic growth, population and household formation, energy prices (e.g., world oil price and the price of refined petroleum products, regional natural gas prices, and electricity prices), technological change, and policy decisions. Varying any of these assumptions could have a material impact on the emissions outlook.

In constructing the emissions projections, alternate pathways of key drivers of emissions were modelled to explore a range of plausible emissions growth trajectories. The baseline emissions projections scenario represents the mid-range of these variations, but remains conditional on the future path of the economy, world energy markets and government policy. The assumptions and key drivers are listed in this section. Alternative cases are explored in the sensitivity analysis in Annex 2.5.

Table A2.30: Summary of Key Price-Related Assumptions Used in Projection Analysis from 1990 to 2030

	Historical							Projected	
	1990	1995	2000	2005	2010	2015	2017	2020	2030
Oil Price (2017 US$/bbl)	39	26	39	65	87	50	52	63	69
Natural Gas Price (2017 US$/mmbtu)	3	2	6	10	5	3	3	2	3
CPI (1992 = 100)	93	104	114	127	139	151	155	165	201

Table A2.31: Summary of Key Economic and Demographic Assumptions Used in Projection Analysis from 1990 to 2030 (average annual percent change)

	Historical					Projected		
	1990-1995	1995-2000	2000-2005	2005-2010	2010-2017	2017-2020	2020-2025	2025-2030
Real GDP	1.7%	4.1%	2.6%	1.2%	2.0%	1.7%	1.8%	1.6%
Population	1.1%	0.9%	1.0%	1.1%	1.0%	1.4%	1.0%	1.0%
Population of driving age (18–75)	1.3%	1.2%	1.3%	1.4%	1.1%	1.0%	0.8%	0.7%
Labour Force	0.6%	1.5%	1.8%	1.3%	0.9%	1.0%	0.8%	0.6%

Table A2.32: Summary of Key Agriculture Assumptions Used in Projection Analysis from 1990 to 2030 (average annual percent change)

	Historical	Projected		
	2010-15	2015-20	2020-25	2025-30
Total Crops	1.8	0.44	0.18	0.25
Total Cattle	-1.2	-0.29	0	0.8
Total Hogs	0.14	0	0.11	-0.14
Total Poultry	1.84	3.49	1.33	1.18

A2.3.1 Key Economic Drivers and Assumptions

The emissions projections baseline scenario is designed to incorporate the best available information about economic growth as well as energy demand and supply into the future. The projections capture the impacts of future production of goods and services in Canada on GHG emissions.

Historical data on GDP and disposable personal income are provided from Statistics Canada. Consumer price index and population demographics are also produced by Statistics Canada while historical emissions data are provided by the *National Inventory Report*, 2019 (NIR 2019). Economic projections (including GDP, exchange rates and inflation) to 2023 are calibrated to Finance Canada's March 2019 Budget Fiscal Outlook. Economic projections between 2024 and 2030 are based on Finance Canada's long term projections.

Forecasts of oil and natural gas price and production are taken from the Canada Energy Regulator's *Canada's Energy Future 2019: Energy Supply and Demand Projections to 2040* – December 2019.[31] The CER is an independent federal agency that regulates international and interprovincial aspects of the oil, gas and electric utility industries. The U.S. Energy Information Administration's outlook on key parameters is also taken into account in the development of energy and emissions trends.

A2.3.2 Economic Growth

The Canadian economy grew by 1.7% per year over 2005 through 2017, a period that includes the 2009 global recession. Real GDP growth is expected to average 1.7% per year from 2017 to 2030.

Growth in the labour force and changes in labour productivity influence Canada's real GDP. Labour productivity is expected to increase by an average of 0.7% annually between 2017 and 2020, an improvement over the 0.6% average annual growth during the period between 2005 and 2017. The increase in productivity is attributed to an expected rise in capital formation, and contributes to the growth in real disposable personal income, which is expected to increase by an average of 2.2% per year between 2017 and 2020 and 1.8% between 2020 and 2030.

Table A2.33: Macroeconomic Assumptions, 1990–2030 Average Annual Growth Rates

	Historical	Projected	
	2005 to 2017	2017 to 2020	2020 to 2030
Gross Domestic Product	1.7%	1.7%	1.7%
Consumer Price Index	1.7%	1.9%	2.0%

31 https://www.cer-rec.gc.ca/nrg/ntgrtd/ftr/2019/index-eng.html.

A2.3.3 Population Dynamics and Demographics

The population size and its characteristics (e.g., age, sex, education, household formation, among others) have important impacts on energy demand. Canada's overall population is projected to grow on average at an annual rate of 1.4% between 2017 and 2020, slowing to 1.0% per year between 2020 and 2030.

Major demographic factors that can have measurable impacts on energy consumption are summarized below:

- Household formation: This is the main determinant of energy use in the residential sector. The number of households is expected to increase on average by 1.4% per year between 2017 and 2020 and by an average of 1.0% per year between 2020 and 2030.
- Labour force: This is expected to have a decelerating growth rate, reflecting the aging population. Its annual average growth rate was 1.1% per year between 2005 and 2017, and is projected to slow to 1.0% per year between 2017 and 2020 and then slow further to 0.7% between 2020 and 2030.

A2.3.4 World Crude Oil Price

A major factor in projected GHG emissions is the assumption about future world oil prices since this drives the level of production of oil. Canada is a price taker in crude oil markets as its share of world oil production and consumption are not large enough (5% and 2%, respectively)[32] to significantly influence international oil prices. West Texas Intermediate (WTI) crude oil is used as an oil price benchmark. North American crude oil prices are determined by international market forces and are most directly related to the WTI crude oil price at Cushing, which is the underlying physical commodity market for light crude oil contracts for the New York Mercantile Exchange. The increase in North American supply and the resulting transportation bottleneck at Cushing have created a divergence between the WTI price of crude oil and the Brent price of crude oil. As such, the North American oil market is currently being priced differently from the rest of the world.

The emissions outlook's WM Scenario is anchored by the world oil price assumptions developed by the CER. According to the CER, the world crude oil price for WTI is projected to rise from about 52 Canadian dollars (C$) per barrel of oil (bbl) in 2017 to about C$63/bbl in 2020 and C$69/bbl in 2030. Higher and lower price scenarios are used for the sensitivity analysis in Annex 2.5.1 of this report.

Figure A2.10 shows crude oil prices for light crude oil (WTI) and heavy crude oil (WCS). Historically the price of heavy oil/ bitumen (Alberta Heavy) has followed the light crude oil price (WTI) at a discount of 50% to 60%. However, in 2008 and 2009 the differentials between the prices of light and heavy crude oils ("bitumen/light-medium differential") narrowed significantly owing to a global shortage of heavier crude oil supply. Moreover, Alberta's Provincial government has extended oil production limits to December 31st 2020, due to continuing infrastructure constraints. Extended curtailment is expected to lead to short-term price increases of heavy crude oil until production restrictions are lifted.

The Canadian Canada Energy Regulator (CER) expects the bitumen/light-medium differential to average between US$12 and US$30 by anticipating that Canadian crude oil exports will continue to exceed existing pipeline export capacity over the coming years. [33]

32 https://www.nrcan.gc.ca/energy/oil-sands/18086.

33 https://www.CER-one.gc.ca/nrg/ntgrtd/ftr/2018/chptr2-eng.html.

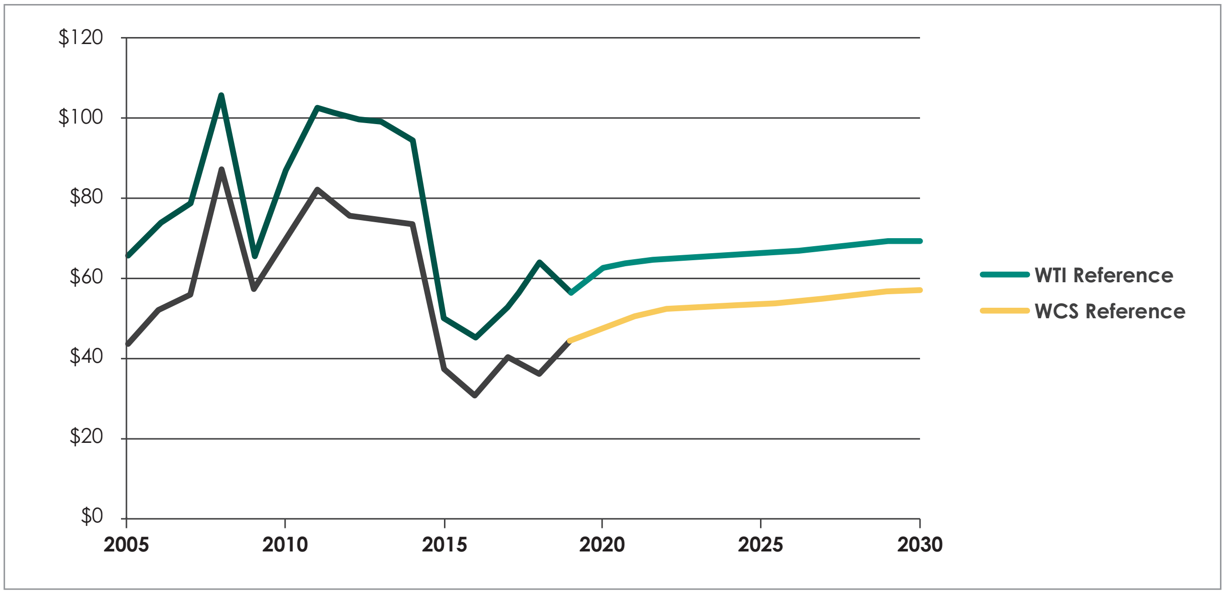

Figure A2.10: Crude Oil Price: WTI and Alberta Heavy (US$ 2017/bbl)

As shown in Figure A2.11, the Henry Hub price for natural gas in Alberta (the benchmark for Canadian prices) increased in 2017 to about 3.11 Canadian dollars per million British thermal units (MMBtu). Oversupply of natural gas throughout the North American economy, beginning in 2019, has led to decreases in the Henry Hub benchmark price throughout the first few years of the projection. Natural gas prices are forecasted to rebound starting in 2021, and reach about C$2.88 per MMBtu by 2025 and then C$3.42 per MMBtu by 2030.

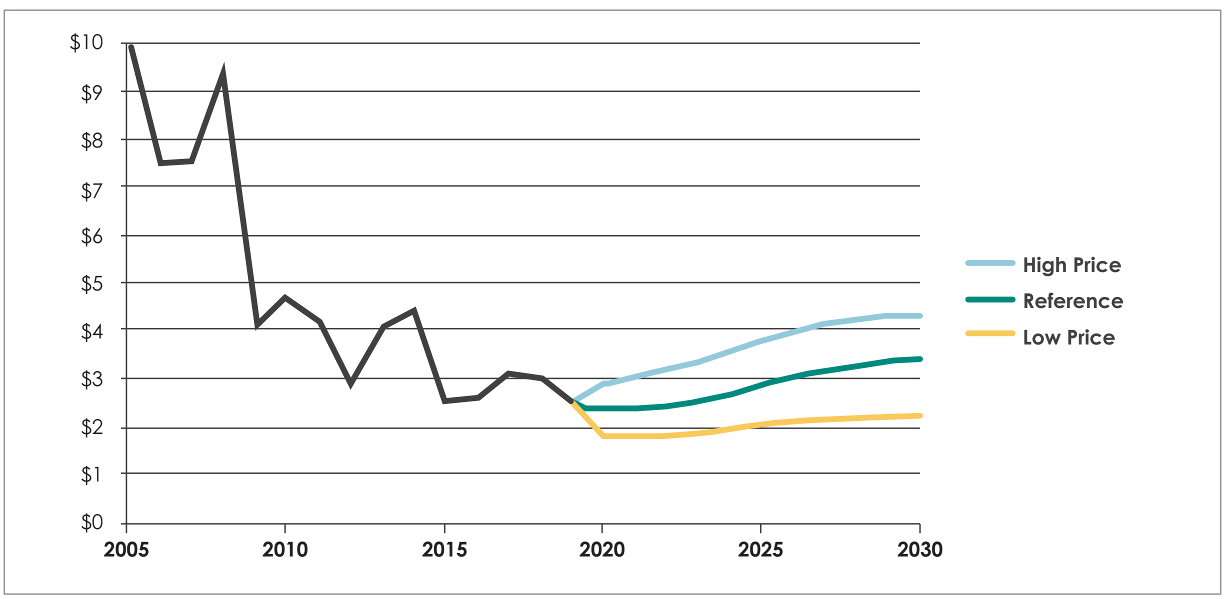

Figure A2.11: Henry Hub Natural Gas Price ($US 2017/MMbtu)

Table A2.34: Crude Oil Production (thousand barrels per day)

	Historical		Projected	
	2005	2017	2020	2030
Crude and Condensates	**1 533**	**1 545**	**1 879**	**2 275**
Conventional Heavy	526	404	602	637
Conventional Light	511	590	667	806
C5 and Condensates	173	330	455	675
Frontier Light (offshore + northern)	323	221	155	157
Oil Sands	**1 065**	**2 838**	**3 277**	**4 105**
Oil Sands: Primary	151	202	212	287
Oil Sands: In Situ	288	1 360	1 427	2 085
Steam - assisted Gravity Drainage	83	1 112	1 165	1 721
Cyclic Steam Stimulation	205	248	261	365
Oil Sands Mining	627	1 276	1 639	1 733
Total Production (gross)	**2 598**	**4 383**	**5 156**	**6 381**

A2.3.5 Energy and Electricity Production

CER projections illustrate that growth in both conventional natural gas and conventional oil production will be outstripped by unconventional extraction methods, as a result of declining supply of conventional resources and recent improvements to unconventional extraction methods and technology. As such, under assumed prices and absent further government policy actions, it is expected that from 2017 to 2030 oil sands in situ production will increase by about 50% and oil sands mining production will increase by 35% (see Table A2.34).

There are two main products from oil sands production: synthetic crude oil (or upgraded bitumen) and non-upgraded bitumen, which is sold as heavy oil. Table A2.35 illustrates historical and projected oil sands disposition. Synthetic crude oil production is projected to slowly increase from about 1.11 million barrels per day (bbl p/d) in 2017 to about 1.24 million bbl p/d by 2020 and then to about 1.33 million bbl p/d by 2030. Non-upgraded bitumen will increase from 1.61 million bbl p/d in 2017 to 1.90 million bbl p/d by 2020 and then to 2.64 million bbl p/d by 2030. This non-upgraded bitumen is either sold as heavy oil to Canadian refineries or transported to U.S. refineries for upgrading to refined petroleum products.

Table A2.35: Oil Sands Disposition (thousand barrels per day)

	Historical		Projected	
	2005	2017	2020	2030
Oil Sands (gross)	**1 066**	**2 838**	**3 277**	**4 105**
Oil Sands (net)	983	2 723	3 141	3 976
Synthetic	611	1 113	1 243	1 335
Non-upgraded Bitumen	371	1 610	1 898	2 641
Own Use	86	115	136	129

Projections show gross natural gas production will remain steady at about 7.2 trillion cubic feet (TCF) in 2020, as new production and non-conventional sources such as shale gas and coal-bed methane come to market and offset the continued decline in conventional gas production. These new sources of natural gas production increase output to 8.0 TCF by 2030.

Table A2.36: Natural Gas Production (billion cubic feet)

	Historical		Projected	
	2005	2017	2020	2030
Natural Gas Supply	**6 596**	**6 504**	**7 581**	**7 898**
Marketable Gas	**6 264**	**5 653**	**5 807**	**6 589**
Gross Production	7 753	6 954	7 193	7 994
Own-use Consumption	1 489	1 301	1 386	1 405
Imports	332	851	1 773	1 309
Liquefied Natural Gas Production	**0**	**0**	**0**	**839**

The electricity forecast is determined by the interaction between electricity demand from end-use sectors, which changes for each sector depending on fuel and electricity prices, technology choices, efficiency changes, policy impacts, and economic driver growth, and source of electricity supplied. The source of electricity supplied depends on the historical state of each province and territory's supply mix as well as scheduled refurbishments and retirements, planned and modelled additions to capacity, growing industrial generation and interprovincial and international flows. Government actions further constrain supply choices in the forecast, such as the expected retirement of coal units due to the 2012 federal coal-fired electricity regulations, and renewable portfolio standards in provinces such as Nova Scotia and Alberta that mandate the addition of new renewable generation.

Gross electricity demand is projected to grow 9% from 2017 to 2030 as economic growth and fuel-switching outpace electrical efficiency improvements. However, utility electricity generation is only expected to increase by 2% over the same period. This is due to two significant supply-side changes in the forecast period. First, net exports of electricity to the USA fall by about 22% from 2017 to 2030 as major exporting provinces use increasingly more electricity domestically. Second, industrial generation is projected to increase by almost 41%, partly offsetting the need for utility generation to meet growing industrial electricity demands. Industrial generation includes both on-site hydropower generation, common in the aluminum industry in Québec, and cogeneration, which produces electricity alongside heat and steam used for industrial processes, such as biomass combustion in the pulp and paper sector and own-use gas-fired cogeneration in the oil and gas sector. Emissions associated with industrial generation are allocated to the specific industrial sector, rather than to the electricity sector, which captures only utility-generated emissions.

While total utility generation is expected to grow very slowly, the mix changes significantly between 2017 and 2030, with generation from coal, refined petroleum products such as fuel oil and diesel, and nuclear power being replaced by increasing renewables and natural gas generation. While the reduction of nuclear generation in Ontario results in some new, higher-emitting natural gas, Ontario generally replaces nuclear with non-emitting generation or imports, and most of this new natural gas goes to replacing coal in other provinces as it is phased out, reducing the emissions intensity of electricity generation in most provinces in the forecast.

Table A2.37: Electricity Supply and Demand (Terawatt hours)

	Historical				Projected	
	2005	2010	2015	2017	2020	2030
Electricity Required	**606**	**593**	**646**	**650**	**653**	**686**
Total Gross Demand	551	537	552	557	569	610
Purchased from Grid	*505*	*490*	*499*	*504*	*510*	*539*
Own Use	*46*	*46*	*53*	*53*	*59*	*71*
Net Exports	24	26	62	61	54	44
Exports	*44*	*44*	*73*	*71*	*66*	*60*
Imports	*20*	*19*	*11*	*10*	*12*	*16*
Losses	31	30	32	32	30	32
Electricity Produced	**606**	**593**	**650**	**650**	**655**	**688**
Utility Generation	554	542	580	584	580	595
Coal and Petroleum Coke	*102*	*84*	*66*	*57*	*27*	*1*
Refined Petroleum Products	*10*	*3*	*4*	*4*	*1*	*1*
Natural Gas	*23*	*32*	*35*	*30*	*58*	*53*
Nuclear	*87*	*86*	*96*	*95*	*74*	*70*
Hydro	*327*	*321*	*345*	*362*	*371*	*396*
Other Renewables	*5*	*16*	*34*	*36*	*50*	*70*
Industrial Generation	52	51	70	66	75	93
Coal and Petroleum Coke	*0*	*0*	*0*	*0*	*0*	*1*
Refined Petroleum Products	*1*	*1*	*1*	*1*	*1*	*1*
Natural Gas	*16*	*20*	*32*	*28*	*36*	*50*
Hydro	*31*	*27*	*33*	*31*	*31*	*33*
Other Renewables	*4*	*4*	*4*	*6*	*7*	*8*

A2.3.6 Emissions Factors

Table A2.38 provides a rough estimate of carbon dioxide equivalent emissions emitted per unit of energy consumed by fossil fuel type for combustion and industrial processes. These numbers are estimates based on latest available data. Specific emission factors can vary slightly by year, sector, and province.

Table A2.38: Mass of CO_2 eq Emissions Emitted per Quantity of Energy for Various Fuels

Fuel	CO_2 eq Emission Factor (g/MJ)
Aviation Gasoline	74.25
Biodiesel	5.26
Biomass	5.55
Coal	91.01
Coke	110.28
Coke Oven Gas	36.72
Diesel	71.39
Ethanol	2.5
Gasoline	71.71
Heavy Fuel Oil	75.31
Jet Fuel	69.41
Kerosene	65.81
Light Fuel Oil	71.16
LPG	36.98
Lubricants	58.1
Naphtha Specialties	17.77
Natural Gas	47.1
Natural Gas Raw	57.18
Other Non-Energy Products	36.41
Petrochemical Feedstocks	14.22
Petroleum Coke	84.61
Renewable Natural Gas	0.39
Still Gas	51.8
Waste	79.02

A2.3.7 Federal, Provincial and Territorial Measures

A large number of federal, provincial and municipal policies and measures currently exist in Canada that are aiming to reduce GHG emissions, or energy consumption. Some of these have been fully implemented (e.g., methane regulations that have received royal assent), while others are still in the development or planning stages. ECCC applies a set of criteria for a policy to be included in the WM scenario. These criteria include:

1. The policy has the necessary legislative and financial support;
2. The measure is expected to produce meaningful reductions (at least 100 kilotonnes of CO_2 eq.);
3. There is sufficient quantifiable information available to estimate the impact of the policy/ measure; and,
4. The measure is incremental to other policies/ measures already included in the model.

The WM scenario does not take into account the impact of broader strategies or future measures within existing plans where significant details are still under development.

Announced policies that have not satisfied the criteria for the WM scenario could still be included in the WAM scenario, if expected reductions are meaningful, and if there is sufficient information available to model it. ECCC engages with provinces and territories in extensive consultations to ensure their initiatives are accounted for in analysis and modeling of emissions projections.

Under the Pan-Canadian Framework on Clean Growth and Climate Change a number of policies and measures have been announced. As the policy development process is not yet finished, some of these policies were not included in the WM scenario, but were included in the WAM scenario.

Table A2.39 identifies the major federal, provincial and territorial measures that are included in the WM and WAM scenarios. This includes measures that have been implemented or announced in detail as of September 2019. Where program funding is set to end, the projections assume that the impacts of these programs, other than those embodied in consumer behaviour, cease when the approved funding terminates.

Table A2.39: GHG Measures Reflected in WM and WAM Scenarios

Provincial/Territorial Measures	Federal Measures
With Measures (WM Scenario)	
Adoption of the National Energy Code for Buildings of Canada (2010-2012) by all provinces and territories	• Federal Backstop Carbon Pollution Pricing • Amendments accelerating the phase out of coal-fired generation of electricity and performance standards for natural gas electricity generation[34] • Energy Innovation Program • Incentives for Zero Emission Vehicles • Electric Vehicle Charging and Alternative Fuel Refuelling Infrastructure • Public Transit Investments • Emerging renewables and smart grids • Off-diesel energy systems in remote communities • 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) • Equipment Standards (Amendment 13) • Voluntary emission reductions for planes and trains • Light-duty vehicles 1 (LDV-1) GHG emissions standards for the light-duty vehicle model years 2011 to 2016 • Light-duty vehicles 2 (LDV-2) GHG emissions standards increases stringency for model years 2017 to 2025 • 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)* • Accelerating Industrial Energy Efficiency Management • Low-Carbon Economy Challenge Fund • Low-Carbon Economy Leadership Fund • Strategic Interconnections in electricity (British Columbia – Alberta, Manitoba – Saskatchewan)
Renewable Fuel Content across all provinces and territories (except for Newfoundland and Labrador, Yukon, the Northwest Territories and Nunavut)	
Newfoundland and Labrador • Muskrat Falls hydro project • Newfoundland and Labrador carbon pricing	
Nova Scotia • Nova Scotia's carbon pricing system • Cap on GHG emissions from the electricity sector • Renewable portfolio standard for electricity generation • Electricity demand-side management policies • *Solid Waste-Resource Management Regulations*	
New Brunswick • Renewable Portfolio Standard	
Québec • 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 • Renewable natural gas mandate (5% by 2025)	
Ontario • Ethanol in Gasoline Regulation (increasing ethanol content in gasoline to 10% by 2020) • 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 Québec • Ontario Natural Gas 2015-2020 Conservation Framework • Ontario Electricity 2015-2020 Conservation Framework	
Manitoba • Manitoba Building Code Section 9.36 (for housing) • Efficiency Manitoba Act	

34 A number of provinces are currently working with the Government of Canada on Equivalency agreements in lieu of the amended coal-fired electricity regulations.

Provincial/Territorial Measures	Federal Measures
Saskatchewan • Adoption of the Building Codes • Boundary Dam 3 Carbon Capture Project • *Uniform Building and Accessibility Standards Regulations* (2013)	
Alberta • Alberta's Technology Innovation and Emissions Reduction System (TIER) • 100 Mt cap for oil sands • Quest carbon capture and storage project • Carbon Trunk Line Project – CO_2 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	

British Columbia
• Carbon tax increasing to \$35 in 2018, \$40 in 2019, \$45 by 2020 and \$50 in 2021
• CleanBC plan:
    • ZEV mandate and incentives
    • Tailpipe Emissions Standard
    • Heat Pump Incentive
    • Organic Waste Diversion and Landfill gas
    • Renewable Natural Gas Standard
    • Industrial Electrification
    • Carbon Capture and Storage
    • CleanBC for Industry
• British Columbia Cement Low Carbon Fuel Program
• Renewable and Low Carbon Fuel Requirements Regulation (20% reduction in CI by 2030)
• 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), a ZEV mandate and support for zero emissions vehicle charging stations in buildings
• Step Code: Increased Energy Efficiency Requirements in the Building Code
• Energy Efficiency Standards Regulation on gas-fired boilers
• Regulation Enabling Utilities to Incent Natural Gas Vehicles	

Northwest Territories • Biomass Strategy	

Provincial/Territorial Measures	Federal Measures
With Additional Measures (WAM Scenario)	
Québec • WCI credits (Assumes Québec meets its legislated emissions targets through purchases of WCI allowances.) Manitoba • Expanded ethanol and biodiesel mandate (10% ethanol and 5% biodiesel by 2020)	• Clean Fuel Standard • Additional strategic Interconnections in electricity (Manitoba – Saskatchewan, Québec – New Brunswick, Québec – Nova Scotia, Newfoundland – Nova Scotia) • Net-zero energy ready building codes (for new commercial and residential buildings) by 2030 • Labelling and codes for existing buildings (retrofits) • More stringent Energy Efficiency Standards for appliances and equipment • Regulations for off-road industrial, commercial, residential and recreational vehicles • Post-2025 LDV regulations • Increased use of wood in buildings construction

Canadian provinces and territories have committed to taking action on climate change through various programs and regulations. In the WM scenario, provincial and territorial targets are not modelled. Instead, individual policies that are brought forward as methods to attain the provincial targets may be included in the modeling platform if they meet the criteria discussed above. Table A2.40 lists the emissions reductions targets announced by each province or territory.

Table A2.40: Announced GHG Reduction Targets of Provincial/Territorial Governments

Province / Territory	Target in 2020	Target in 2030	Target in 2050
Newfoundland and Labrador	10% below 1990	30% below 2005	75% to 85% below 2001
Prince Edward Island	10% below 1990	40% below 2005	
Nova Scotia	10% below 1990	53% below 2005	Net-zero emissions
New Brunswick	Total emissions output of 14.8 Mt/CO_2e	Total emissions output of 14.1 Mt/CO_2e	Total emissions output of 5 Mt/CO_2e
Québec	20% below 1990	37.5% below 1990	80% to 95% below 1990
Ontario	17% below 2005	30% below 2005	N/A
Manitoba	1Mt CO2e cumulative reduction (2018-2022)		
Saskatchewan			
Alberta			
British Columbia		40% below 2007	80% below 2007
Nunavut			
Yukon		30% below 2010	
Northwest Territories		30% below 2005	

A2.3.8 Pricing Carbon Pollution

The Government of Canada's federal stringency requirements for pricing carbon pollution ensures that carbon pollution pricing applies to a wide range of sources in all jurisdictions in Canada, with increasing stringency over time.

Under the *Greenhouse Gas Pollution Pricing Act*, the federal carbon pollution pricing system has two parts: a regulatory trading system for large industry, known as the Output-Based Pricing System (OBPS); and a regulatory charge on fuel (fuel charge).[35] The federal system (either one part or both) applies in jurisdictions that opted for it or that have not established their own pollution pricing systems that meet the federal stringency requirements.

A2.4 Modeling and Methodological Differences from Canada's 3rd Biennial Report

Macroeconomic assumptions and oil and gas price and production forecasts have been updated. LNG production is now expected to come online in the forecast, which was not included in the NC7/BR3 WM scenario.

Several other modeling improvements have been made over the last two years:

- Historic and projected overnight capital costs, fixed costs and operating and maintenance costs for various electric generating technologies were revised to be consistent with the U.S. Energy Information Administration and National Energy Modeling System (NEMS).
- Efficiencies for lighting, geothermal and air source heat pumps were updated with more recent industry forecasts.
- The modelling of phase 2 of the heavy-duty vehicles regulations was adjusted to reflect changes to the impacts of the regulation as estimated in CG2.
- Market shares of zero emission vehicles (ZEV) were aligned to Transport Canada's 2018 ZEV Reference Case, which reflects the elimination of Ontario's ZEV rebates.
- Expansion of the technology set in Freight Transportation to allow for alternative fuels including electricity, hydrogen and natural gas.
- Oil and gas production module has been in the works over several years. This year the module has been used for the first time in development of the sensitivity scenarios, where the oil and gas price and production levels deviate from the main scenario.

A2.5 Sources of Uncertainty and Sensitivity Analysis

A2.5.1 Sensitivity Analysis

Given the uncertainty regarding the key drivers of GHG emissions, the emissions projections for the WM scenario presented in Chapter 5 should be considered as one estimate within a range of plausible outcomes. Future developments in technologies and the rate of resource extraction cannot be foreseen with certainty. Typically, these key uncertainties are addressed through examining alternative cases. The sensitivity analysis presented here focuses on two key uncertainties: the future rate of economic growth and the evolution of world fossil fuel prices and their impact on macroeconomic growth and energy consumption.

In Table A2.41, the emissions outcomes of these alternative cases are presented independently and in various combinations. These alternative cases explore the interaction of energy markets and economic growth, and their impact on emissions, under a range of assumptions.

35 PCF Synthesis Report. Available online at https://www.canada.ca/en/services/environment/weather/climatechange/pan-canadian-framework.html.

Table A2.41: Sensitivity Analysis

Scenario	GHG Emissions in 2030	Difference Between 2005 and 2030
Fast GDP - High World Oil Prices	729	-1
High World Oil Prices	703	-28
Fast GDP	697	-33
With Measures Scenario	673	-57
Slow GDP	646	-85
Low World Oil Prices	617	-114
Slow GDP - Low World Oil Prices	583	-147
Range	583 to 729	-147 to -1

In our scenario with slow GDP, slow population growth and low world oil prices, GHG emissions could be as low as 583 Mt CO2 eq by 2030 on the low end. On the high end, emissions could be 729 Mt CO2 eq in our scenario with fast GDP, high population growth and high world oil prices. This represents a range of 146 Mt CO2 eq.

Oil and gas price assumptions are taken from the CER's 2018 high and low scenarios. The price forecasts are inputted to the Endogenous Oil and Gas Supply Module (EOGSM), which creates a development and production response to changes in commodity prices. In EOGSM, the development and investment decisions by industry is primarily driven by the given Oil and Gas play's estimated return on investment, which is determined in part by supply costs and the given benchmark price. This forms the basis and structure of the high and low alternative emissions scenarios. The fast and slow GDP assumptions were derived from the 2019 *Annual Energy Outlook* by the U.S. Energy Information Administration. Population growth assumptions were derived by applying the relative differences between Statistics Canada's 2013 high, M1 and low scenarios to the population growth from our WM scenario. Figure A2.12 illustrates how differing price and GDP growth assumptions in various combinations might impact Canadian GHG emissions through 2030.

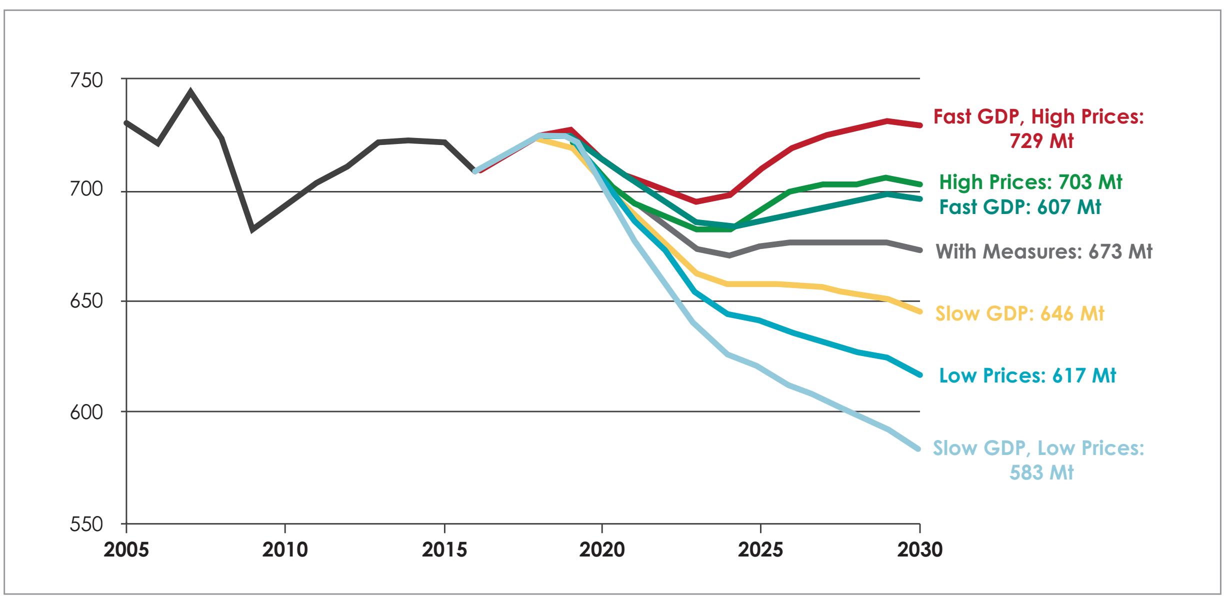

Figure A2.12:Projected GHG Emissions under Full Range of Alternative Economic Assumptions (excluding LULUCF)

Among all scenarios, 2017 is the last year of historical data. In 2019, the different scenarios already begin to diverge. By 2020, there is an 11 Mt CO2 eq range in emissions, which increases to 146 Mt CO2 eq in 2030. In 2029, there is a noticeable drop in emissions in all seven of the scenarios, due to the federal accelerated coal phase out.

Note that the high and fast scenarios intersect around 2024 and the slow and low scenarios intersect around 2021. For the low and slow scenarios, this crossing can be explained by the lag between the effect of slow GDP growth on heavy industry and the effect of low world oil price on oil and gas. Since growth of Canada's heavy industry sector is closely tied to that of GDP, the slow GDP growth scenario has much lower emissions in the heavy industry sector compared to the WM scenario. When world oil prices are low, Canada's oil and gas production suffers, but its heavy industry sector grows slightly due to lower fuel costs. The opposite is true for the fast growth and high price scenarios. Table A2.42 contains a sectoral breakdown of the 2030 emissions levels in the various alternate emission scenarios.

Table A2.42: Projected Difference in GHG Emissions Between the WM scenario and the Alternate Emission Scenarios by Sector (excluding LULUCF) in Mt CO2 eq in 2030

Sector	Fast GDP-High World Oil Price	High World Oil Prices	Fast GDP	Slow GDP	Low World Oil Prices	Slow GDP-Low World Oil Prices
Oil and Gas	29	28	0	-1	-60	-61
Electricity and Steam	7	3	4	-3	-7	-11
Transportation	12	3	8	-7	-3	-12
Heavy Industry	6	-4	8	-13	11	-5
Buildings	0	-1	1	-1	1	0
Agriculture	0	0	0	0	0	0
Waste and Others	3	-1	2	-2	2	-2
Grand Total	**56**	**29**	**24**	**-28**	**-57**	**-90**

The range of oil and gas emissions between scenarios is 89 Mt of CO_2 eq. This represents 61% of the total range of emissions in the alternate emissions scenarios, reflecting the sector's overall contribution to Canadian emissions and its sensitivity to the highly uncertain driver of world oil and gas prices. This year's sensitivity analysis includes asymmetrical emissions and production responses between high and low price scenarios. The differences in oil and gas production between the WM and low price scenarios are larger than the differences in oil and gas production between the WM and high price scenarios. This is a result of the supply costs inputted into the Endogenous Oil and Gas Supply Module that dictates most high cost producers have a near-zero return on investment, at the given low oil and gas prices. This in turn significantly reduces the financial incentive to continue planned development throughout the majority of oil and gas plays throughout Canada.

Moreover, modifications to the industrial cogeneration sector in the WM scenario have resulted in higher emissions reductions in the electricity and steam sector, most notably in the low oil and gas price scenarios. This year's WM scenario more accurately models and forecasts Alberta's and Saskatchewan's industrial cogeneration sector, which results in less displacement of electricity generation from coal and natural gas. Since electricity generation is accounted for in the electricity and steam sector, and cogeneration is accounted for in the oil and gas sector, this has led to a realignment of emissions reductions between both sectors, which is most apparent in the low world oil and gas price scenarios.

A2.5.2 Other Sources of Uncertainty for Canada's GHG Projections

Other factors sources of uncertainty than the ones discussed above also influence the projections, including relating to the decision-making of agents under given assumptions and the pace of clean technology development and adoption. For instance, the observed consumer adoption of emerging technologies may diverge from model predictions due to the influence of behavioral decision-making processes not captured in the model. For example, the diffusion of electric vehicles depends not only on relative vehicle prices, but also consumer awareness of electric vehicles, and the availability of recharging infrastructure both of which will evolve over time and are therefore hard to predict when looking at historical behaviour. This source of projection uncertainty is present across all economic sectors with the rapid emergence of new and cleaner technologies.

Some sources of uncertainty are also specific to sectors, several of which are listed below.

- **Oil and Gas**: As mentioned in the Canada's Canada Energy Regulator 2019 Energy Futures report,[36] Canadian oil and gas production projections vary significantly depending on wold price assumptions. The global price itself is determined by supply and demand for oil, driven by factors like economic growth, technological developments, and geopolitics and is set in international markets.
- **Electricity**: From the demand side, key factors of uncertainty other than economic and population growth, include electricity demand changes arising from the electrification of vehicles or industrial processes. From the supply side, emissions are affected by changes to the supply mix, for example, assumptions for new generating capacity as coal units are being phased out, future costs of renewables, the degree of localized small-scale generation by renewable energy sources, and construction of new transmission linkages.
- **Transportation**: Over the short term, vehicle-kilometers travelled is the key driver of emissions, influenced by assumptions regarding factors such as population, fuel prices and optimization of freight trucks (increased tonnage per km) and freight transportation volume resulting from changes in economic activity. Over the medium to long term, the changing characteristics of the fleet will be important and will be influenced by government policies, different types of vehicles respective production costs, technological development and consumer choices.
- **Heavy Industry**: Emissions are primarily driven by expected economic growth in each subsector. Future technological developments that would affect the costs of electrification and carbon capture and storage technologies, as well as of other energy efficiency improvements would also have an impact on emissions.
- **Buildings**: Emission projections in this sector will be affected by consumer response to emerging technologies and government policies. Future relative fuel prices and technology costs will also have an impact.
- **Agriculture**: Emissions from agriculture production are affected by production costs such as fertilizer prices, and international prices of agricultural commodities that affect the crop composition and livestock size.

A2.6 Projections and Contribution of the Land Use, Land Use Change and Forestry Sector and Modeling Methodologies

A2.6.1 Introduction

This Annex describes reporting, projecting, and accounting for emissions and removals occurring in the Land Use, Land-Use Change and Forestry (LULUCF) sector in Canada. Table A2.43 below outlines the scope of LULUCF reporting included in Canada's National GHG Inventory Report (NIR), as well as the scope of LULUCF accounting included in Canada's 2020 and 2030 emission reductions targets.

36 https://www.cer-rec.gc.ca/nrg/ntgrtd/ftr/2019/index-eng.html.

Previous technical reviews of Canada's National Communications and Biennial Reports noted that the information required to understand the LULUCF contribution to targets was spread over different sections of the National Communication, Biennial Report, and NIR. This Annex, therefore, aims to include all relevant information on LULUCF reporting, projecting and accounting in one place to provide a clear and comprehensive picture of Canada's LULUCF sector.

Table A2.43: Scope of LULUCF reporting and accounting

	Reporting	Accounting	
Purpose	**National GHG Inventory Report**	**2020 Emissions Reductions Target***	**2030 Emissions Reductions Target****
Scope	Forest Land	Forest Land	Forest Land
	Cropland	Cropland	Cropland
	Grassland	Grassland	Grassland
	Wetlands	Wetlands	Wetlands
	Settlements	Settlements	Settlements
	Harvested Wood Products	Harvested Wood Products	Harvested Wood Products
	Other Lands		

*Consistent with its quantified economy-wide emission reduction target for 2020 under the Copenhagen Accord, Canada intends to account for LULUCF in 2020. However, projections are not yet available for all sub-sectors. The scope of accounting for this report therefore reflects the current availability of data (see Sections A2.6.3 and A2.6.4).

** Consistent with its Nationally Determined Contribution (NDC) for 2030 under the Paris Agreement, Canada intends to account for LULUCF in 2030. However, projections are not yet available for all sub-sectors. The scope of accounting for this report therefore reflects the current availability of data (see Sections A2.6.3and A2.6.4).

A2.6.2 LULUCF in the National Greenhouse Gas Inventory

As described in Chapter 6 of Canada's 2019 NIR covering the period 1990-2017, subsequently referred to as NIR2019,[37] the LULUCF sector reports GHG fluxes between the atmosphere and Canada's managed lands (Forest Land, Cropland, Grassland, Wetlands, Settlements, and Other Land), including those associated with land-use change and emissions from harvested wood products (HWP) derived from these lands. LULUCF includes emissions and removals of carbon dioxide (CO_2); additional emissions of methane (CH_4) and nitrous oxide (N_2O)[38] due to controlled biomass burning (but not emissions due to biomass used as fuel, which are reported under the Energy sector); CH_4 and N_2O from wetland drainage and rewetting due to peat extraction; and N_2O released following Land converted to Cropland.

In 2017, the estimated net GHG flux in the LULUCF sector, calculated as the sum of GHG emissions and CO_2 removals, was a net removal of 24 Mt (Table A2.44) or 3.3% of total GHG emissions. The time series of LULUCF sector estimates is available in Table 10 of the common reporting format (CRF) series for NIR2019.[39] Values are rounded to two significant figures (except for values under 1 kt, which are rounded to the first decimal) based on the same rounding protocol used in the Canada's NIR.

37 https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/national-inventory-submissions-2019

38 Consistent with NIR2019, GHG emissions from LULUCF shown in the tables in this Annex do not include carbon monoxide (CO) estimates. Carbon emissions in the form of CO are reported in NIR2019 (CRF Table 4) but not included in the sectoral totals, and are instead reported as indirect CO_2 emissions in CRF Table 6.

39 https://unfccc.int/documents/194947

Table A2.44: Historical LULUCF sector net GHG flux estimates for selected years

	Net GHG flux (kt CO2 eq)[a]							
LULUCF Sub-sectors	**1990**	**2005**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
A. Forest Land	**-210 000**	**-160 000**	**-160 000**	**-160 000**	**-160 000**	**-150 000**	**-150 000**	**-150 000**
Forest Land remaining Forest Land (FLFL)[b]	-210 000	-150 000	-160 000	-160 000	-160 000	-150 000	-150 000	-150 000
Land converted to Forest Land (LFL)	-1 100	-950	-650	-590	-540	-500	-440	-390
B. Cropland[c]	**8 300**	**-11 000**	**-11 000**	**-10 000**	**-9 500**	**-8 600**	**-7 800**	**-6 800**
Cropland remaining Cropland (CLCL)	-1 300	-15 000	-14 000	-13 000	-12 000	-11 000	-10 000	-9 600
Land converted to Cropland (LCL)	9 600	3 900	2 700	2 800	2 800	2 700	2 700	2 800
C. Grassland	**0.6**	**0.9**	**1.6**	**1.9**	**0.8**	**1.2**	**1.2**	**1.2**
Grassland remaining Grassland (GLGL)	0.6	0.9	1.6	1.9	0.8	1.2	1.2	1.2
Land converted to Grassland (LGL)	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	**5 300**	**3 100**	**3 000**	**3 000**	**3 100**	**2 900**	**2 900**	**3 200**
Wetlands remaining Wetlands (WLWL)	1 500	2 600	2 500	2 400	2 400	2 500	2 600	2 800
Land converted to Wetlands (LWL)	3 800	470	540	670	710	420	340	330
E. Settlements	**3 800**	**3 800**	**3 700**	**3 800**	**3 900**	**3 900**	**3 800**	**3 500**
Settlements remaining Settlements (SLSL)	-2 400	-2 400	-2 400	-2 400	-2 400	-2 400	-2 400	-2 400
Land converted to Settlements (LSL)	6 200	6 200	6 100	6 200	6 300	6 300	6 200	5 900
F. Other Land	**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**
G. Harvested Wood Products (HWP)[d]	**130 000**	**140 000**	**130 000**	**130 000**	**130 000**	**130 000**	**130 000**	**130 000**
HWP from FLFL	120 000	140 000	130 000	130 000	130 000	130 000	130 000	130 000
HWP from *Forest Conversion*	3 100	3 000	2 800	3 000	2 900	2 900	2 800	2 600
Total LULUCF[e]	**-68 000**	**-21 000**	**-36 000**	**-33 000**	**-32 000**	**-25 000**	**-25 000**	**-24 000**
Forest Conversion[f]	*22 000*	*16 000*	*15 000*	*15 000*	*15 000*	*15 000*	*14 000*	*14 000*

a Negative sign indicates net removals of CO_2 from the atmosphere.

b Wetlands subject to forest management practices are not included in NIR estimates due to a lack of suitable activity data and science to quantify the short, medium and long-term impacts of management on net GHG emissions.

c Wetlands converted to Cropland and subject to agricultural management practices are not included in inventory estimates due to a lack of suitable activity data and science to quantify the short, medium and long-term impacts of conversion and management on net GHG emissions.

d Emissions are shown separately for HWP from FLFL and HWP from *Forest Conversion* because they are accounted differently (see Section A2.6.4).

e Totals may not add up to due to rounding.

f Shown for information only. *Forest Conversion* overlaps with the sub-sectors of Cropland remaining Cropland (CLCL), Land converted to Cropland (LCL), Wetlands remaining Wetlands (WLWL), Land converted to Wetlands (LWL), Land converted to Settlements (LSL) and Harvested Wood Products (HWP).

NE = Not Estimated, NO = Not Occurring.

Starting with NIR2017, and consistent with the 2019 IPCC Refinement to the 2006 Guidelines for GHG Inventories, Canada has implemented a Tier 3 approach for estimating anthropogenic emissions and removals from Forest Land remaining Forest Land (FLFL). Under this approach, emissions and removals from managed forest stands that have been impacted in recent history by significant natural disturbances (such as wildfires and insect infestations) are tracked separately from anthropogenic emissions and removals, and only considered anthropogenic when the forest stands have reached commercial maturity or pre-disturbance aboveground biomass, depending on the type of disturbance. As a result, the FLFL estimates reported in Canada's NIR focus on anthropogenic emissions and removals. Non-anthropogenic emissions and removals associated with significant natural disturbances are also provided in the NIR for information and transparency. For further information, please refer to Section 6.3.1 and Annex 3.5.2 of NIR2019.

A2.6.3 LULUCF Projections

Canada's LULUCF projections are shown in Table A2.45 and descriptions of the modelling approaches used to produce the projections are provided below. Emissions and removals from the LULUCF sector are modelled separately from other sectors (e.g. energy, transport, etc.). Additionally, individual LULUCF sub-sectors are projected using different models and methodologies. Given that projections are not yet available for all LULUCF sub-sectors, Table A2.45 shows the sub-sectors and parts of sub-sectors for which projections are currently available (shading indicates where projections are not available). As a result, some of the historical information in Table A2.45 differs from Table A2.44. Table A2.45 is provided to show historical information that is consistent with projections in order to facilitate understanding of the accounting projections (see Section A2.6.4). Work is ongoing to increase the scope of LULUCF projections for future reports.

Table A2.45: Net GHG flux estimates for selected years from LULUCF sub-sectors for which projections are currently available

LULUCF Sub-sectors	Net GHG flux (kt CO_2 eq)									
	Historical Estimates								Projected Estimates	
	1990	2005	2012	2013	2014	2015	2016	2017	2020	2030
A. Forest Land	**-210 000**	**-160 000**	**-160 000**	**-160 000**	**-160 000**	**-150 000**	**-150 000**	**-150 000**	**-150 000**	**-140 000**
Forest Land Remaining Forest Land (FLFL)	-210 000	-150 000	-160 000	-160 000	-160 000	-150 000	-150 000	-150 000	-150 000	-140 000
Land converted to Forest Land (LFL)	-1 100	-950	-650	-590	-540	-500	-440	-390	-240	0
B. Cropland	**8 400**	**-11 000**	**-11 000**	**-10 000**	**-9 200**	**-8 400**	**-7 500**	**-6 600**	**-4 900**	**-1 500**
Cropland remaining Cropland (CLCL)[a]	-900	-14 000	-14 000	-13 000	-12 000	-11 000	-10 000	-9 200	-7 300	-3 600
Land converted to Cropland (LCL)[b]	9 300	3 800	2 600	2 700	2 600	2 500	2 500	2 600	2 400	2 100
C. Grassland[c]										
Grassland remaining Grassland (GLGL)										
Land converted to Grassland (LGL)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands[d]	**2 800**	**1 500**	**1 300**	**1 400**	**1 500**	**1 200**	**1 200**	**1 200**	**940**	**540**
Wetlands remaining Wetlands (WLWL)	610	1 100	970	960	940	940	930	920	540	460
Land converted to Wetlands (LWL)	2 200	390	300	480	520	240	240	240	400	79
E. Settlements[e]	**6 200**	**6 200**	**6 000**	**6 200**	**6 300**	**6 300**	**6 100**	**5 900**	**5 600**	**4 500**
Settlements remaining Settlements (SLSL)										
Land converted to Settlements (LSL)	6 200	6 200	6 000	6 200	6 300	6 300	6 100	5 900	5 600	4 500
F. Other Land	**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**
G. Harvested Wood Products (HWP)	**130 000**	**140 000**	**130 000**	**130 000**	**130 000**	**130 000**	**130 000**	**130 000**	**130 000**	**130 000**
HWP from FLFL	120 000	140 000	130 000	130 000	130 000	130 000	130 000	130 000	130 000	130 000
HWP from *Forest Conversion*	3 100	3 000	2 800	3 000	2 900	2 900	2 800	2 600	2 600	2 400
Total (of sub-sectors for which projections are available)[f]	**-68 000**	**-20 000**	**-35 000**	**-31 000**	**-31 000**	**-24 000**	**-25 000**	**-23 000**	**-22 000**	**-10 000**
Forest Conversion[g]	*22,000*	*16,000*	*15,000*	*15,000*	*15,000*	*15,000*	*14,000*	*14,000*	*13,000*	*11,000*

a Historical estimates and projections do not include net emissions from agricultural woody biomass, as these projections are not yet available.

b Historical estimates and projections are only for Forest Land converted to Cropland.

c No projections are available for grasslands.

d Historical estimates and projections are only for Forest Land converted to Wetlands.

e Historical estimates and projections are only for Forest Land converted to Settlements.

f Totals may not add up to due to rounding.

g Shown for information only. *Forest Conversion* overlaps with the sub-sectors of Cropland remaining Cropland (CLCL), Land converted to Cropland (LCL), Wetlands remaining Wetlands (WLWL), Land converted to Wetlands (LWL), Land converted to Settlements (LSL) and Harvested Wood Products (HWP).

NE = Not Estimated, NO = Not Occurring.

A. Forest Land

Canada's National Forest Carbon Monitoring Accounting and Reporting System (NFCMARS) builds on information in Canada's National Forest Inventory and on additional provincial and territorial forest inventory information. Natural Resources Canada (NRCan) developed and maintains the Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3) as the core model of NFCMARS. CBM-CFS3 is a Tier 3 forest carbon dynamics estimation tool that is fully consistent with the IPCC inventory guidelines.

NFCMARS provides annual estimates of GHG emissions and removals as affected by forest management, natural disturbances, and land-use change. NRCan, in collaboration with the Canadian Space Agency, uses remote sensing and other data to monitor the area annually disturbed by wildfires, and maintains a deforestation monitoring program to estimate the area annually affected by conversion of forest to non-forest land uses. NFCMARS has been in place since 2006 and is described in detail in NIR2019.

NFCMARS is used to produce the projections shown here, using assumptions about human activities in the future. This ensures that the projections are fully consistent with historical emission estimates. For Forest Land remaining Forest Land (FLFL), projections are based on the same methodologies used for the production of Canada's FLFL estimates for NIR2019. Harvesting is the human activity with the greatest impact on this sub-sector. Canada has based its projections on the latest available projected harvest estimates from provincial and territorial governments. Given the high variability of natural disturbances from year to year, for 2018 onward projections assume that wildfire occurs at the same average annual rate of area burned as in 1990-2017.

For Land converted to Forest Land (LFL), projections are based on average historical rates, consistent with estimates reported in the NIR2019. However, as LFL activity data are not available from 2009 onward, LFL projections are based on a conservative assumption of zero afforestation from 2009 onward.[40] As planned improvements to LFL estimates are implemented over the coming years and reflected in future NIRs, these projections are expected to change.

Wetlands subject to forest management practices are not included in the Forest Land sub-sector. Work is ongoing to develop suitable activity data and associated estimates.

B. Cropland

Agriculture and Agri-Food Canada (AAFC) generates GHG estimates for Cropland remaining Cropland (CLCL) by using two models that it maintains: the Canadian Regional Agricultural Model (CRAM) and the Canadian Agricultural Greenhouse Gas Monitoring Accounting and Reporting System (CanAG-MARS). CRAM is used to estimate the resource use patterns in the agriculture sector for projections; these resource use patterns are fed into CanAG-MARS to generate emissions/removals estimates for CLCL.

CRAM is a static partial equilibrium economic model that provides a detailed characterization of agriculture activities in Canada. CRAM's features include coverage of all major cropping activities, livestock production and some processing, detailed provincial

40 This assumption is considered to be conservative because it underestimates LFL removals from 2009 onward, which in turn underestimates the contribution toward lowering Canada's GHG emissions for 2020 and 2030.

and/or sub-provincial breakdown of activities and a detailed breakdown of cropping production practices including choice of tillage regime, use of summer fallow, and stubble. CRAM is calibrated to the 2016 Census of Agriculture and all resource use patterns are aligned to the census. As CRAM is a static model, crop and livestock production estimates from AAFC's 2019 Medium Term Outlook (MTO) are used to set future resource use patterns for 2020 and 2030.

CanAG-MARS reports on GHG sources and sinks resulting from changes in land use and land management practices (LUMC) in Canada's agricultural sector. The estimation procedure follows a Tier 2 methodology under the 2006 IPCC Guidelines and is described in detail in NIR2019.

The amount of organic carbon retained in soil represents the balance between the rate of primary production (carbon transfer from the atmosphere to the soil) and soil organic carbon decomposition (carbon transfer from the soil to the atmosphere). How the soil is managed can determine whether the amount of organic carbon stored in soil is increasing or decreasing. The estimation procedure is based on the premise that changes in soil management influence the rate of soil carbon gains or losses for a period of time following a land management change (LMC).

Carbon emissions and removals on mineral soils are estimated by applying country-specific, spatially disaggregated carbon emission and removal factors multiplied by the relevant area of land that undergoes a management change. The carbon factor represents the rate of change in soil carbon per unit area for each LMC as a function of time since the land management change.

For Cropland remaining Cropland (CLCL), projections were based on the 2020 and 2030 resource use patterns generated within CRAM. These resource use patterns were integrated with the activity data used by CanAG-MARS to generate emissions/removals estimates for NIR2019. This ensures that the approach used to generate the projection estimates was consistent with that used in the NIR.

The historical CLCL emissions in Table A2.44 include the removal of 440 kt each year by woody biomass, a value provided by Environment and Climate Change Canada (ECCC) – Science and Technology Branch. Since no methodology has been developed to date to make projections for emissions and removals from woody biomass on CLCL, this removal is excluded from the values provided in Table A2.45 to avoid a methodological artefact when estimating the accounting contribution from CLCL.

Projected emissions from Forest Land converted to Cropland are provided by ECCC – Science and Technology Branch as part of estimates for Forest Land converted to other sub-sectors (see discussion of *Forest Conversion* projections below). No methodology has been developed yet to make projections for the conversion of Grassland to Cropland.

Wetlands subject to agricultural management practices are not included in the Cropland sub-sector. Work is ongoing to develop suitable activity data and associated estimates.

C. Grassland

Very little information is available on management practices on Canadian agricultural grassland and, while there are no detailed comprehensive activity data, there is no evidence to suggest that current management practices are degrading grasslands. Emissions of CH_4 and N_2O from prescribed burning in managed grassland are reported in Canada's NIR. Work is ongoing to determine to what extent management of grasslands can impact GHG emissions. To date, no methodology has been developed yet to project GHG emissions from Grassland remaining Grassland (GLGL).

D. Wetlands

For the purpose of Canada's NIR, the Wetlands category is restricted to those wetlands that are not already in the Forest Land, Cropland or Grassland categories. Emissions of CO_2, CH_4 and N_2O from peatlands managed for peat extraction, rewetted peatlands and flooded lands (hydroelectric reservoirs) are reported in Canada's NIR. To date, no methodology has been developed to make projections for emissions from peat extraction, rewetting and from the surface of reservoirs. However, projected emissions from Forest Land converted to Wetlands are provided by ECCC – Science and Technology

Branch as part of estimates for Forest Land converted to other sub-sectors (see discussion of *Forest Conversion* projections below).

E. Settlements

The drivers of urban tree cover change are currently not sufficiently well understood to provide reliable projections of the resulting emissions and removals. However, projected emissions from Forest Land converted to Settlement are provided by ECCC – Science and Technology Branch as part of estimates for Forest Land converted to other sub-sectors (see discussion of *Forest Conversion* projections below).

F. Other Land

In accordance with the land category definitions developed and adopted in Canada, and which are provided in Section 6.2 of NIR2019, Other Land comprises areas of rock, ice or bare soil, and all land areas that do not fall into any of the other five sub-sectors (e.g. A to E in Table A2.44 and Table A2.45) and which are classified as unmanaged land. Emissions for Other Land remaining Other Land are not currently estimated (hence the use of "NE" in the tables), whereas the conversion from other sub-sectors to Other Land does not occur in Canada (hence the use of "NO" in the tables).

G. Harvested Wood Products (HWP)

Canada has developed a country-specific model, the National Forest Carbon Monitoring, Accounting and Reporting Systems for Harvested Wood Products (NFCMARS-HWP), to monitor and quantify the fate of carbon from domestic harvest. The HWP category is reported following the Simple Decay approach, as described in the annex to Volume 4, Chapter 12 of the 2006 IPCC Guidelines. The approach is similar to the Production Approach, but differs in that the HWP pool is treated as a carbon transfer related to forest harvest and therefore does not assume instant oxidation of wood in the year of harvest (for further detail see NIR2019, Annex 3.5.3).

Emissions associated with this category result from the use and disposal of HWP manufactured from wood coming from forest harvest on Forest Land remaining Forest Land (see Section A2.6.3.A) and from *Forest Conversion* (see Section A2.6.3.H) in Canada and consumed either domestically or elsewhere in the world. Products disposed of at the end of their useful life are assumed to be immediately oxidized.

Projected emissions from HWP use the same assumptions as used for HWP estimates for NIR2019, for example that the pool of HWP starts in 1900, with emissions occurring over time. These projections also reflect assumptions about future harvests (as provided by provincial and territorial governments), future forest conversion rates, and future end-uses of the harvest. The latter are based on the most recent annual (i.e. 2017) share of harvest in each of the four HWP commodity categories (sawnwood, panels, pulp and paper, and other products). It is assumed that using the most recent shares will reflect important emerging trends in wood product use, e.g. the decline in the use of some types of paper.

H. Forest Land Converted to Other Land Categories - Forest Conversion

Forest Conversion is not a LULUCF reporting category in the NIR, because it overlaps with the reporting sub-sectors of Cropland remaining Cropland (CLCL), Land converted to Cropland (LCL), Wetlands remaining Wetlands (WLWL), Land converted to Wetlands (LWL), Land converted to Settlements (LSL), and Harvested Wood Products (HWP). *Forest Conversion* is nevertheless reported as an information item in Canada's NIR, and is therefore reported as an information item in this Annex. For the purpose of this report, *Forest Conversion* includes all immediate and residual emissions from FL converted to CL, WL, and SL (see Table A2.44 and Table A2.45).

Historical estimates for *Forest Conversion* are developed based on an earth observation sampling approach with resulting emission impacts calculated using NRCan's Carbon Budget Model and ECCC's Peat-Extraction and Reservoir models. *Forest Conversion* estimates take into account activity extending from 1970 to 2017, and were developed by driver and end land use categories (Cropland, Wetlands, and Settlements).

Projected *Forest Conversion* estimates are developed by NRCan based on a business-as-usual scenario of *Forest Conversion* activity for the 2018-2030 period, using the best available knowledge of drivers, policies and practices. Projections use an empirical model; model parameters were derived by driver and ecological region based on the relationship between areas converted and resulting emissions as reported in the most recent NIR submission. All emissions associated with the use and disposal of HWP manufactured from wood coming from *Forest Conversion* are derived using the IPCC Simple Decay approach (see discussion of HWP in Section A2.6.3.G above).

A2.6.4 Accounting for the contribution from the LULUCF sector

A. General accounting approach

In its 2012 submission to the UNFCCC, Canada stated its intent to include the LULUCF sector in its accounting of GHG emissions towards its 2020 target, noting that emissions and related removals resulting from natural disturbances would be excluded from the accounting.[41] In its submission to the UNFCCC regarding its Nationally Determined Contribution (NDC) for 2030 (revised May 2017), Canada indicated that it intended to account for all IPCC sectors and that it was examining its approach to LULUCF accounting.[42] The revised NDC also stated that Canada will exclude the impacts of natural disturbances and focus on anthropogenic emissions and removals. Canada's Third Biennial Report, submitted in December 2017, noted that work was continuing to develop LULUCF estimates that focus on anthropogenic emissions and removals as a basis for improved reporting and accounting for LULUCF.

Canada has since made significant progress in its analysis of the LULUCF sector. As described in Section A2.6.2 above, Canada has implemented an approach for estimating anthropogenic emissions and removals from FLFL where emissions and removals from forest stands dominated by the impacts of natural disturbances are now tracked separately in the NIR.

When accounting for the LULUCF sector, Canada uses the UNFCCC GHG inventory categories and accounting approaches consistent with those for non-LULUCF sectors, wherever possible. As a result, for each LULUCF sub-sector apart from Forest Land remaining Forest Land (FLFL) and the HWP associated with FLFL, the accounting contribution is determined as the difference between the net emissions in a given year and the net emissions in the base year (2005). This is often referred to as the "net-net" approach.

Given the unique structure of FLFL, which is significantly impacted by the effects of past management and natural disturbances (i.e. the age-class legacy effect), Canada uses the reference level approach for FLFL and the HWP obtained from it. This approach is an internationally agreed and scientifically credible way to focus on changes in human management over time in this complex LULUCF sub-sector.

In this report, projections of the LULUCF accounting contribution are included for those LULUCF sub-sectors or parts of sub-sectors for which emission projections are currently available (see Section A2.6.3). These sub-sectors and parts of sub-sectors represent most of the estimated historical emissions and removals from LULUCF reported in NIR2019. Further work is needed to develop projections for remaining LULUCF sub-sectors based on sound methodologies and an acceptable level of understanding of the impact of the most important drivers of change.

B. The Reference Level accounting approach for FLFL and associated HWP

Canada estimates the contribution from FLFL and associated HWP using the reference level (RL) approach. This approach first involves defining the RL, which is a projection of emissions from FLFL and associated HWP that reflects a continuation of recent forest management policies and practices. For any given year, accounting then involves calculating the difference between actual emissions (or projected emissions, when historical data are not yet available)

41 https://unfccc.int/sites/default/files/resource/docs/2012/awglca15/eng/misc01a02.pdf?download

42 https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Canada%20First/Canada%20First%20NDC-Revised%20submission%20 2017-05-11.pdf

in that year and the pre-defined RL value for the same year. As a result, the contribution reflects the impact of actual management on emissions relative to the impact of the management assumed in the RL. In this way, the RL approach focuses accounting on the impacts of current activities, in line with the principles of accounting agreed under the UNFCCC. The RL approach used is consistent with the methodology used in Canada's 1st Biennial Report. The approach is also consistent with Canada's Forest Management RL, which was constructed according to UNFCCC guidance, submitted to the UNFCCC in 2011, and assessed by international review experts in 2012.[43]

For this report, Canada divides its RL approach into two periods: 2010-2020 and 2021-2030. Consistent with international guidance for RL construction, a 'policy cut-off date' is used to ensure that only existing and implemented policies are reflected in the RL. For the first RL period, the agreed date is 2009 (as RLs were first constructed and submitted in 2011). For the second RL period, Canada uses a cut-off date of 2016, the year in which Canada ratified the Paris Agreement. Accounting results will therefore reflect the impacts of any changes in management implemented after the cut-off dates.

The updated approach to the RL for this report involves establishing assumptions for future harvest volumes over the two RL periods, consistent with policies and practices in place before the cut-off dates. These assumptions use averages of historical harvest data (1990-2009 for the first RL period and 1990-2016 for the second RL period).[44] HWP from FLFL are included using the assumption that the HWP pool starts in 1900 and that emissions from the HWP pool are accounted using the IPCC Simple Decay approach (i.e. the same as is used in the NIR). The future shares of HWP in each product category are assumed to be the same as those in the recent historical period.

C. LULUCF sector accounting contribution

Three tables below show the accounting contributions derived using the approaches described above.

- Table A2.46 presents the contribution from FLFL and associated HWP, showing how it is derived using the RL approach.
- Table A2.47 presents the contribution from all LULUCF sub-sectors in selected historical years based on estimates shown in Table A2.44 for net-net accounting and Table A2.46 for RL accounting.
- Table A2.48 presents the projected contribution in 2020 and 2030 based on estimates shown in Table A2.45 and Table A2.46, for those sub-sectors for which emission projections are available.

Results from Table A2.47 and Table A2.48 cannot be compared directly, because for most LULUCF sub-sectors the scope of available data differs between historical years and projections.[45] In deriving Table A2.46, Table A2.47, and Table A2.48, unrounded numbers are used to calculate the accounting contributions. These results are then rounded according to the rounding protocol explained in Section A2.6.2 above.

43 https://unfccc.int/topics/land-use/workstreams/land-use--land-use-change-and-forestry-lulucf/forest-management-reference-levels

44 Future harvest volumes in Canada are significantly affected by the impacts of past disturbances, most notably mountain pine beetle outbreaks in western Canada and wildfire. In the event that projected RL harvest volumes exceed what is determined to be a sustainable level of harvest (as defined by the annual allowable cut, AAC), a "sustainability safeguard" will be applied to lower any future RL harvest value below the AAC.

45 For example, in CLCL the removals from agricultural woody biomass (see SectionA2.6.3 .B above) are included in historical years but not in projections.

Table A2.46: Calculation of the accounting contribution from Forest Land remaining Forest Land and associated Harvested Wood Products in selected years

	(kt CO_2eq)[a]							
	Historical Values						Projected Values[b]	
	2012	2013	2014	2015	2016	2017	2020	2030
Reference Level values	-33 000	-25 000	-20 000	-10 000	-7 900	-4 100	2 300	5 500
Historical and projected values	-33 000	-31 000	-32 000	-26 000	-27 000	-26 000	-26 000	-16 000
Accounting contribution[c]	300	-6 300	-11 000	-15 000	-19 000	-22 000	-28 000	-21 000

a Negative values represent progress towards lowering Canada's GHG emissions.

b Actual contributions will depend on actual emissions/removals occurring in 2020 and 2030.

c Totals may not add up due to rounding.

FLFL and associated HWP provide the largest share of the overall accounting result and show a growing accounting contribution (see Tables Table A2.46 and Table A2.47) through to 2017 because actual harvest rates continued to remain below the historical average harvest levels used in the RL. After 2020, the projected harvest rates and RL harvest rates increasingly converge, reducing the accounting contribution from FLFL and associated HWP (see Table A2.48).

Table A2.47: Accounting contribution by LULUCF sub-sector in selected historical years

	(kt CO_2eq)[a]						Accounting Approach
LULUCF Sub-sectors	2012	2013	2014	2015	2016	2017	
A. Forest Land[b]							
Forest Land remaining Forest Land (FLFL) and associated HWP	300	-6 300	-11 000	-15 000	-19 000	-22 000	Reference Level
Land converted to Forest Land (LFL)	300	360	410	450	510	560	Net-Net
B. Cropland	**-340**	**670**	**1 600**	**2 400**	**3 300**	**4 200**	**Net-Net**
Cropland remaining Cropland (CLCL)	830	1 800	2 700	3 600	4 500	5 300	Net-Net
Land converted to Cropland (LCL)	-1 200	-1 100	-1 100	-1 200	-1 200	-1 100	Net-Net
C. Grassland	**0.7**	**1.1**	**-0.0**	**0.3**	**0.4**	**0.4**	**Net-Net**
Grassland remaining Grassland (GLGL)	0.7	1.1	-0.0	0.3	0.4	0.4	Net-Net
Land converted to Grassland (LGL)	NO	NO	NO	NO	NO	NO	Net-Net
D. Wetlands	**-35**	**-12**	**27**	**-160**	**-130**	**94**	**Net-Net**
Wetlands remaining Wetlands (WLWL)	-110	-210	-210	-100	2.4	230	Net-Net
Land converted to Wetlands (LWL)	73	200	240	-52	-130	-140	Net-Net
E. Settlements	**-140**	**43**	**75**	**94**	**-41**	**-280**	**Net-Net**
Settlements remaining Settlements (SLSL)	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	Net-Net
Land converted to Settlements (LSL)	-130	47	79	97	-38	-280	Net-Net
F. Other Land	**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**	

G. Harvested Wood Products (HWP)[c]							
HWP from FLFL	IE	IE	IE	IE	IE	IE	Reference Level
HWP from *Forest Conversion*	-240	-30	-95	-170	-220	-400	Net-Net
Total LULUCF[d]	**-150**	**-5 300**	**-9 400**	**-13 000**	**-15 000**	**-17 000**	
Forest Conversion[e]	*-1 600*	*-1 100*	*-1 100*	*-1 600*	*-1 800*	*-2 200*	Net-Net

a Negative values represent progress towards lowering Canada's GHG emissions.

b The FL contribution is not shown here because two different accounting approaches are used to calculate the FL contribution: FLFL and associated HWP is accounted using the reference level approach, whereas LFL is accounted using the net-net approach.

c The HWP contribution is not shown here because two different accounting approaches are used to calculate the HWP contribution. HWP associated with FLFL is included under FLFL and associated HWP. The contribution from HWP from *Forest Conversion* is shown separately.

d Totals may not add up due to rounding.

e Shown for information only. *Forest Conversion* overlaps with the sub-sectors of Cropland remaining Cropland (CLCL), Land converted to Cropland (LCL), Wetlands remaining Wetlands (WLWL), Land converted to Wetlands (LWL), Land converted to Settlements (LSL) and Harvested Wood Products (HWP).

NE = Not Estimated, NO = Not Occurring, IE = Included Elsewhere.

Accounting for *Forest Conversion* uses a Net-Net approach so that changes in the accounting contribution over time reflect trends in *Forest Conversion* rates since 2005. The increasing accounting contribution in 2020 and 2030 (see Table A2.48) compared to the historic contributions in Table A2.47 result from projected steady declines in future *Forest Conversion* rates.

As for CLCL, which also uses a Net-Net approach, carbon removals in the sub-sector have been going down since 2005, resulting in increasing projected accounting debits in 2020 and 2030. Given current trends in land management, the carbon sequestration benefits (i.e. increased soil carbon) from conservation tillage and reduced summerfallow are declining gradually over time as adoption of these practices levels off and soil carbon gains from past adoption approach a new equilibrium. Moreover, in response to changes in demand (i.e. less meat, more plants), there has been and will continue to be a shift away from perennial crops towards annual crops. This shift results in the loss of soil carbon and a lower potential for carbon removals from subsequent management on that land.

Table A2.48 shows that the projected accounting contribution for the total LULUCF sector is a credit of 23 Mt for 2020 and a credit of 15 Mt for 2030.[46]

46 The values published in ECCC's 2018 Canada's Greenhouse Gas and Air Pollutant Emissions Projections report in December 2018 were a credit of 29 Mt for 2020 and a credit of 24 Mt for 2030. The main reasons for the lower projected credits in the BR4 are updates to the agricultural census data (showing a stronger shift away from perennial crops towards annual crops) and revised Reference Level harvest rates in British Columbia to better account for the impacts from the mountain pine beetle outbreak during the early 2000s.

Table A2.48: Projected accounting contribution by LULUCF sub-sector in 2020 and 2030

LULUCF Sub-sectors	(kt CO_2eq)[a]		
	2020	2030	Accounting Approach[b]
A. Forest Land[c]			
Forest Land remaining Forest Land (FLFL) and associated HWP	-28 000	-21 000	Reference Level
Land converted to Forest Land (LFL)	720	950	Net-Net
B. Cropland[d]	**5 700**	**9 100**	**Net-Net**
Cropland remaining Cropland (CLCL)	7 200	11 000	Net-Net
Land converted to Cropland (LCL)	-1 500	-1 700	Net-Net
C. Grassland[e]			**Net-Net**
Grassland remaining Grassland (GLGL)			Net-Net
Land converted to Grassland (LGL)	NO	NO	Net-Net
D. Wetlands[f]	**-560**	**-970**	**Net-Net**
Wetlands remaining Wetlands (WLWL)	-570	-650	Net-Net
Land converted to Wetlands (LWL)	3.1	-320	Net-Net
E. Settlements[g]	**-580**	**-1 600**	**Net-Net**
Settlements remaining Settlements (SLSL)			Net-Net
Land converted to Settlements (LSL)	-580	-1 600	Net-Net
F. Other Land	**NE, NO**	**NE, NO**	
G. Harvested Wood Products (HWP)[h]			
HWP from FLFL	IE	IE	Reference Level
HWP from *Forest Conversion*	-470	-670	Net-Net
Total (of sub-sectors for which projections are available)[i]	**-23 000**	**-15 000**	
Forest Conversion[j]	*-3 100*	*-5 300*	Net-Net

a Negative values represent progress towards lowering Canada's GHG emissions.

b Actual contributions will depend on actual emissions/removals occurring in 2020 and 2030.

c The FL contribution is not shown here because two different accounting approaches are used to calculate the FL contribution: FLFL and associated HWP is accounted using the reference level approach, whereas LFL is accounted using the net-net approach.

d Projections are available only for Cropland remaining Cropland (CLCL, excluding agricultural woody biomass) and Forest Land converted to Cropland.

e No projections are available.

f Projections are available only for Forest Land converted to Wetlands.

g Projections are available only for Forest Land converted to Settlements.

h The HWP contribution is not shown here because two different accounting approaches are used to calculate the HWP contribution. HWP associated with FLFL is included under FLFL and associated HWP. The contribution from HWP from *Forest Conversion* is shown separately.

i Totals may not add up due to rounding.

j Shown for information only. *Forest Conversion* overlaps with the sub-sectors of Cropland remaining Cropland (CLCL), Land converted to Cropland (LCL), Wetlands remaining Wetlands (WLWL), Land converted to Wetlands (LWL), Land converted to Settlements (LSL) and Harvested Wood Products (HWP).

NE = Not Estimated, NO = Not Occurring, IE = Included Elsewhere.

A2.7 Methodology for Development of Emissions Scenarios

The scenarios developed to support Canada's GHG emissions projections derive from a series of plausible assumptions regarding, among others, population and economic growth, prices, demand and supply of energy, and the evolution of energy efficiency technologies. With the exception of the WAM and Technology scenarios, the projections also assume no further government actions to address GHG emissions beyond those already in place as of September 2019.

The emissions projections presented in this report cannot be viewed as a forecast or prediction of emissions at a future date. Rather, this report presents a simple projection of the current structure and policy context into the future, without attempting to account for the inevitable but as yet unknown changes that will occur in government policy, energy supply, demand and technology, or domestic and international economic and political events.

The emissions projections have been developed in line with generally recognized best practices. They incorporate IPCC standards for estimating GHG emissions across different fuels and processes, rely on outside expert views and the most up-to-date data available for key drivers such as economic growth, energy prices, and energy demand and supply, and apply an internationally recognized energy and macroeconomic modeling framework in the estimation of emissions and economic interactions. Finally, the methodology used to develop the projections and underlying assumptions has been subject to peer review by leading external experts on economic modeling and GHG emissions projections, as well as vetted with key stakeholders.

The approach to developing Canada's GHG emissions projections involves two main features:

- Using the most up-to-date statistics on GHG emissions and energy use, and sourcing key assumptions from the best available public and private expert sources.
- Developing scenarios of emissions projections using E3MC, a detailed, proven energy, emissions and economy model for Canada.

A2.7.1 Up-To-Date Data And Key Assumptions

Each year, ECCC updates its models using the most recent data available from Statistics Canada's Report on Energy Supply and Demand in Canada and Canada's National Inventory Report (NIR). Historical GHG emissions are aligned to the latest NIR. For these projections, the most recent historical data available were for 2017.

In addition to the most recent historical information, the projections are based on expert-derived expectations of key drivers (e.g., world oil price). Projections are based on the latest energy and economic data, with key modeling assumptions aligned with Government of Canada and provincial/territorial government views:

- Canada Energy Regulator (CER) views on energy prices and large-scale energy projects.
- Economic projections (including GDP, exchange rates and inflation) to 2023 are calibrated to Finance Canada's March 2019 Budget Fiscal Outlook. Economic projections between 2024 and 2030 are based on Finance Canada's long term projections.
- Population growth projections are from provincial/territorial consultations.

Even with the benefit of external expert assumptions, there is considerable uncertainty surrounding energy price and economic growth assumptions, particularly over the medium- to long-term. As such, a range of emissions is presented representing a series of sensitivity analyses. These cases were based on high and low GDP growth as well as high and low oil prices and production levels.

A2.7.2 Energy, Emissions and Economy Model For Canada

The projections presented in this report were generated from ECCC's E3MC model. E3MC has two components: Energy 2020, which incorporates Canada's energy supply and demand structure; and the in-house macroeconomic model of the Canadian economy.

Energy 2020 is an integrated, multi-region, multisector North American model that simulates the supply of, price of, and demand for all fuels. The model can determine energy output and prices for each sector, both in regulated and unregulated markets. It simulates how such factors as energy prices and government measures affect the choices that consumers and businesses make when they buy and use energy. The model's outputs include changes in energy use, energy prices, GHG emissions, investment costs, and possible cost savings from measures, in order to identify the direct effects stemming from GHG reduction measures. The resulting savings and investments from Energy 2020 are then used as inputs into the macroeconomic model.

Energy 2020 is proprietary software maintained by Systematic Solutions, Inc. and has been used by a variety of organizations, such as government agencies, climate action groups, and utilities, to develop long-term energy and emissions projections and to conduct energy and emissions-related policy analyses. Energy 2020 is a successor to the policy model (FOSSIL2) used by the U.S. Department of Energy from the late 1970s to early 1990s. Energy 2020 has been used by ECCC, Natural Resources Canada and the Canadian Energy Regulator (formerly the National Energy Board) since the early 1990's.

The in-house macroeconomic model is the former Informetrica Model (TIM) containing revised economic data. It is a highly disaggregated Keynesian model designed to provide long-term economic forecasts and impacts of various energy and socioeconomic policies. The macroeconomic model is used to examine consumption, investment, production, and trade decisions in the whole economy. It captures the interaction among industries, as well as the implications for changes in producer prices, relative final prices, and income. It also factors in government fiscal balances, monetary flows, and interest and exchange rates. More specifically, the macroeconomic model incorporates 133 industries at a provincial and territorial level. It also has an international component to account for exports and imports, covering about 100 commodities. The macroeconomic model projects the direct impacts on the economy's final demand, output, employment, price formation, and sectoral income that result from various policy choices. These, in turn, permit an estimation of the effect of climate change policy and related impacts on the national economy.

E3MC develops projections using a market-based approach to energy analysis. For each fuel and consuming sector, the model balances energy supply and demand, accounting for economic competition among the various energy sources. This ensures consistent results among the sectors and regions. The model can be operated in a forecasting mode or an analytical mode. In forecasting mode, the model generates an annual energy and emissions outlook up to 2050. In analytical mode, it assesses broad policy options, specific programs or regulations, new technologies, or other assumptions.

The model's primary outputs are tables showing energy consumption, production and prices by fuel type, year and region. The model also identifies many of the key macroeconomic indicators (e.g., GDP or unemployment) and produces a coherent set of all GHG emissions (such as CO_2, CH_4 and N_2O) by sector and by province or territory. Figure A2.13 shows the general structure of E3MC. The component modules of E3MC represent the individual supply, demand, and conversion sectors of domestic energy markets, and also include the macroeconomic module. In general, the modules interact through values representing the prices of the energy delivered to the consuming sectors and the quantities of end-use energy consumption.

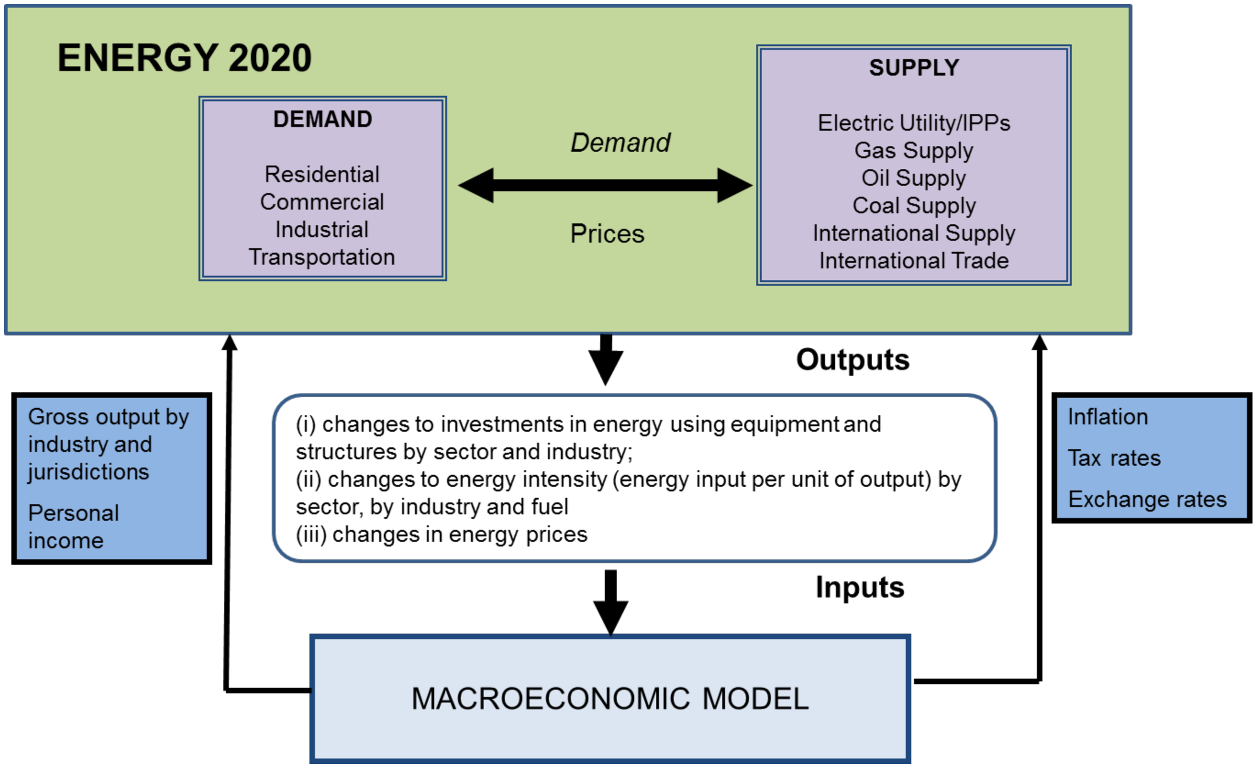

Figure A2.13: Energy, Emissions and Economy Model for Canada

A2.7.3 Treatment of Interaction Effects

The overall effectiveness of Canada's emissions-reduction measures will be influenced by how they interact with each other. Analysis of a policy package containing more than one measure or policy would ideally take into account these interactions in order to understand the true contribution that the policy package is making (in this case, to emission reductions).

E3MC is a comprehensive and integrated model focusing on the interactions between sectors and policies. In the demand sectors, the fuel choice, process efficiency, device efficiency, and level of self-generation of electricity are all integrally combined in a consistent manner. The model includes detailed equations to ensure that all the interactions between these structures are simulated with no loss of energy or efficiency. For example, the electric generation sector responds to the demand for electricity from the energy demand sectors, meaning that any policy to reduce electricity demand in the consumer sectors will impact the electricity generation sector. The model accounts for emissions in the electricity generation sector as well as for emissions in the consumer demand sectors. As the electricity sector reduces its emissions intensity, policies designed to reduce electricity demand in the consumer sectors will cause less of an emissions reduction. The model also simulates the export of products by supply sectors.

Taken as a whole, the E3MC model provides a detailed representation of technologies that produce goods and services throughout the economy, and can simulate, in a realistic way, capital stock turnover and choices among technologies. The model also includes a representation of equilibrium feedbacks, such that supply and demand for goods and services adjust to reflect policy. Given its comprehensiveness, E3MC covers all the GHG emissions sources, including those unrelated to energy use.

A2.7.4 Additionality

Additionality represents what would have happened without a specific initiative. Problems of additionality arise when the stated emissions reductions do not reflect the difference in emissions between equivalent scenarios with and without the initiative in question. This will be the case if stated emissions reductions from an initiative have already been included in the WM scenario: emissions reductions will effectively be double-counted in the absence of appropriate adjustments. The E3MC model controls for additionality by basing its structure on incremental or marginal decision-making. The E3MC model assumes a specific energy efficiency or emission intensity profile at the sector and end-use point (e.g., space heating, lighting, or auxiliary power). Under the E3MC modeling philosophy, if the initiative in question were to increase the efficiency of a furnace, for example, only the efficiency of a new furnace would be changed. The efficiency of older furnaces would not change unless those furnaces are retired and replaced with higher-efficiency ones. As such, any change in the model is incremental to what is reflected in the business-as-usual assumptions.

A2.7.5 Free Ridership

A related problem, free ridership, arises when stated reductions include the results of behaviour that would occur regardless of the policy. This can occur when subsidies are paid to all purchasers of an item (e.g., a high-efficiency furnace), regardless of whether they purchased the item because of the subsidy. Those who would have purchased the product regardless are termed free riders. In the E3MC model, the behaviour of free riders has already been accounted for in the WM scenario. Thus, their emissions are not counted toward the impact of the policy. Instead, the E3MC model counts only the incremental take-up of the emissions-reducing technology.

A2.7.6 The Rebound Effect

This describes the increased use of a more efficient product resulting from the implied decrease in the price of its use. For example, a more efficient car is cheaper to drive and so people may drive more. Emissions reductions will generally be overestimated by between 5% and 20% unless estimates account for increased consumption because of the rebound effect.

Within the model, ECCC has mechanisms for fuel choice, process efficiency, device efficiency, short-term budget constraints, and cogeneration, which all react to changes in energy and emissions costs in different time frames. All of these structures work to simulate the rebound effect. In the example above, the impact of extra kilometres that may be driven as a result of improved fuel efficiency is automatically netted out of the associated emissions-reduction estimates.

A2.7.7 Simulation of Capital Stock Turnover And Endogenous Technological Change

As a technology vintage model, E3MC tracks the evolution of capital stocks over time through retirements, retrofits, and new purchases, in which consumers and businesses make sequential acquisitions with limited foresight about the future. This is particularly important for understanding the implications of alternative time paths for emissions reductions.

The model calculates energy costs (and emissions) for each energy service in the economy, such as heated commercial floor space or person-kilometres traveled. In each period, capital stocks are retired according to an age-dependent function (although the retrofitting of unretired stocks is possible, if warranted by changing economic or policy conditions). Demand for new stocks grows or declines depending on the initial exogenous forecast of economic output (i.e., a forecast that is external to the model and not explained by it) and the subsequent interplay of energy supply–demand with the macroeconomic module. A model simulation iterates between energy supply–demand and the macroeconomic module until there is a convergence. The global convergence criterion is set at 0.1% between iterations. This convergence procedure is repeated for each year over the simulation period.

The E3MC model simulates the competition of technologies at each energy service node in the economy, based on a comparison of their cost and some technology-specific controls, such as a maximum market share limit in cases where a technology is constrained by physical, technical or regulatory means from capturing all of a market. The technology choice simulation reflects the financial costs as well as the consumer and business preferences, revealed by real-world historical technology acquisition behaviour.

A2.7.8 Model Strengths and Weaknesses

While E3MC is a sophisticated analytical tool, no model can fully capture the complicated interactions associated with given policy measures between and within markets or between firms and consumers.

The E3MC model has a broad model boundary that captures the complex interactions that occur between producers, consumers and the environment across all energy sectors in the Canadian context. In addition, E3MC has an explicit causal structure that can be used to understand the origins of the patterns of behavior observed and also captures capital stock dynamics. Combined with the fact that it is calibrated to the Canadian experience, these provide considerable flexibility for the modeling of energy and environmental policies.

Unlike computable general equilibrium models, the E3MC model does not fully equilibrate government budgets and the markets for employment and investment. That is, the modeling results reflect rigidities such as unemployment and government surpluses and deficits. The model, as used by ECCC, also does not generate changes in nominal interest rates and exchange rates, as would occur under a monetary policy response to a major economic event. Consequently, the model is not designed to undertake welfare analysis.

Finally, the model lacks endogenous technological change for the industrial and transportation sectors. As a result, the E3MC model is not well-suited to modeling disruptive technological changes.

ANNEX 3 INTERNATIONAL FINANCE

A3.1 Project-Level Breakdown of Canadian Facilities at Multilateral Development Banks

Canadian Facility	Canadian Contribution (million $US)
Canadian Climate Fund for the Private Sector in Asia (Asian Development Bank)	
PHASE I	
Adjaristsqali Hydropower Project	15
Sarulla Geothermal Power Generation Project	20
Cambodia Solar Power Project	3.3
Samoa Solar Power Development	1
ASEAN Regional Distributed Power Project	20
Institutional Capacity Building of Indonesia Eximbank	0.2
Climate Friendly Agribusiness Value Chains Sector Project	1
S-PPTA for the Development of Solar Power IPP	0.2
Banten and South Sulawesi Wind Power Development	0.5
Sermsang Khushig Khundii Solar Project	0.2
Olam: Inclusive, Sustainable and Connected Value Chain	0.4
Climate-Resilient Hazelnut Value Chain	1.3
PHASE II	
Eastern Indonesia Renewable Energy Project	30
Upper Trishuli-1 Hydropower Project (Nepal)	30
Kandahar Solar Power Project (Afghanistan)	3.8
Canadian Climate Fund for the Private Sector in the Americas (Inter-American Development Bank)	
PHASE I	
Le Castellana Wind	5
Achiras Wind	10
Cubico Alten Solar PV	19.5
San Juan Solar PV	10
X-Elio Solar PV Project	12.3
Providencia Solar PV Project	30
TicoFrut Biomass Cogeneration Plant	2.4
El Olivo Solar PV Project	1.9
Alturas de Ovalle Solar PV Project	1.5
Natelu - Solar PV Project in Uruguay	6.1
Yarnel - Solar PV Project in Uruguay	6.4
Hidrowarm - Hydropower Project	10
Los Loros Solar Photovoltaic Power Project	16.6
La Jacinta Solar Power Project	25
Pozo Almonte and Calama Solar Photovoltaic Power Project	20.4
Divisa Solar Project in Panama	6
San Ignacio de Loyola University Energy Efficiency Project	1
Invema Self-Supply Solar	1.5

Optima Energía Energy Efficiency Lighting	6.3
Casablanca and Giacote Solar Project, Uruguay	10
Itelecom Energy Efficient Street Lighting	7
PHASE II	
None approved to date	
Canada Climate Change Fund (International Finance Corporation, World Bank)	
Sri Lanka Agri-finance	5.3
Solar Power in Zambia II	12
Solar Hybrid Systems in Myanmar	6
Wind Power in the Dominican Republic	17
Solar Power in West Bank and Gaza	4
Solar Power in Burkina Faso	10.8
Solar Power in Zambia I	13.3
Energy Efficiency and Renewable Energy in Lebanon II	6
Advisory Services: Agribusiness Adaptation in Nepal	0.2
Advisory Services: Energy & Water Solutions for Corporates in Europe and Central Asia	0.2
Solar PV Installation in Jordan	21.2
Advisory Services: Energy and Resource Efficiency Solutions in Africa	0.3
Advisory Services: Sustainable Hydropower in Nepal	0.2
Advisory Services: Partnership for Cleaner Textiles	0.3
Advisory Services: Clean Energy Lighting in Nigeria	0.2
Advisory Services: Solar Powered Lighting in Pakistan	0.4
Sustainable Energy Financing in Lebanon II	3.5
Sustainable Energy Financing in Bosnia and Herzegovina	2.5
Rooftop Solar in Sri Lanka	7.5
Advisory Services: Sustainable Solar Park in India	0.2
Advisory Services: Municipal Waste Treatment in Serbia	0.3
Biomass Power in the Philippines	39
Renewable Wind Technology in Jamaica	10
Sustainable Energy Financing in Lebanon I	1.5
Energy Efficiency and Renewable Energy in Lebanon I	3
Advisory Services: Sustainable Energy Financing in the Middle East and North Africa	0.5
Advisory Services: Climate Risk Management Pilot	0.5
Advisory Services: Green Buildings Product Development Project	0.6
Hydroelectric Project in Nepal	19.3
Advisory Services: Solid Waste Sector in Albania	0.1
Solar Power Plant in Chile	14.3
Advisory Services: Solid Waste Sector in Uganda	0.3
Energy Efficiency Investment in Bosnia and Herzegovina	10
Advisory Services: Solar Project Development in India	0.1
Advisory Services: Rooftop Solar Power Projects in India	0.1
Advisory Services: Alternative Energy Development in Thailand	0.7
Advisory Services: Sustainable Energy Finance in Honduras	0.05
Advisory Services: Hydropower Installation in Uganda	0.2
Sustainable Energy Financing Business in Albania	1.3
Supporting Green Housing in Kenya	4
Efficiently Increasing Energy Supplies in Ghana	15

Sustainable Energy Financing in Armenia	8
Energy Efficiency for Small and Medium Enterprises in South Africa	2.3
Sustainable Energy Loans for Clean Energy in Honduras	5
Advisory Services: Brazil Hotel Energy Efficiency (Pro-Hotels Program)	0.3
IFC Catalyst Fund	76.5
Blended Climate Finance Program (International Finance Corporation, World Bank)	
Sri Lanka climate-resilient agriculture PLC (Central Finance Company PLC and Alliance Finance Company PLC projects)	5

A3.2 Methodological Approach for Measuring Canada's Climate Finance

In line with 2/CP.17, Annex I, section VI UNFCCC biennial reporting guidelines for developed country Parties, this annex provides background information on the underlying assumptions and methodologies used to produce information on finance for Canada's 4th Biennial Report. Additional definitions are provided in the documentation box as part of reporting guidelines and the Common Tabular Format.

Definitions

- Repayable Contributions: Canada tracks flows that have been returned to Canada from past repayable contributions. These flows are tracked in the year they are received.
- Year of Measurement: Canada is reporting its climate finance by calendar year.
- Reporting Currency/Exchange Rates: Data is reported in Canadian dollars and United States dollars based on OECD Development Assistance Committee (DAC) exchange rates for each relevant year.
- Avoiding Double Counting of Financial Contributions: In line with best international practice, Canada tracks climate finance at the project level. This level of granularity allows for a comprehensive picture of Canada's climate finance and avoids double counting of public flows.
- Climate Finance Provided: Canada refers to "provided" as disbursed in all cases but for FinDev Canada for which "provided" refers to amounts that have been committed. Committed is defined as a firm written obligation to provide resources of a specific amount under specified financial terms and conditions and for specified purposes.
- Support through Export Development Canada: Eligible transactions and projects are identified by EDC using the International Finance Corporation (IFC) "Special Climate" category within the IFC-Definitions and Metrics for Climate-Related Activities.[47] The transaction or project must take place in non-Annex I countries.
- Support through FinDev Canada: Eligible transactions and projects are identified by FinDev Canada using the IFC Definitions and Metrics for Climate Related Activities. Based on committed, the transaction or project must take place in countries listed on the ODA eligibility.[48]

Tracking Climate Finance

Canada has monitoring and evaluation systems in place to effectively track its climate finance. These systems allow for the collection and tracking of detailed project-by-project information based on the parameters defined in the Annex and the Common Tabular Format Documentation Box, and additional indicators to measure results. These reporting parameters and indicators enable the tracking of provision and allow evaluating the effectiveness and impacts of Canada's climate finance.

47 For more information, please visit: IFC-Definitions and Metrics for Climate-Related Activities

48 For a list of ODA eligible recipients, please visit: http://www.oecd.org/dac/stats/daclist.htm

Reporting parameters include: expected results, results achieved, estimated and actual GHG reduction or avoidance, number of people benefitting from adaptation projects.

By tracking both the expected and achieved results at the project level, it is possible to evaluate the success of a project. The success of a project is measured by its achievement of planned outcomes and impacts. Furthermore, by tracking the specific activities of a project it is possible to assess what activities are the most effective at achieving desired outcomes.

Canada works with partners that have clear accountability frameworks. These partners measure and evaluate project results and report back to Canada on outcomes and indicators.

Measuring Mobilized Private Finance

Donor countries are working together to define quantification methodologies and improve the measurement and reporting of publicly mobilized private finance. These processes are paving the way for improved data, enhanced transparency and better harmonization:

- The OECD-led Research Collaborative (RC) for Tracking Finance for Climate Action is exploring options for the development of improved methodologies for measuring private flows mobilized for climate action in developing countries and tracking investment and finance flows towards assessing their consistency with climate objectives.
- The Technical Working Group (TWG), established in 2015, developed a common and robust methodology[49] for measuring mobilized private climate finance towards the US$100 billion goal, building upon the work conducted under RC.
- Collective reporting exercises test methodologies. Canada participated in the report *Climate Finance Provided and Mobilised by Developed Countries in 2013-17* (OECD, 2019).
- The OECD DAC has been working to measure private investment mobilized by official development finance interventions, including climate-related ones.

In accounting for mobilized private climate finance, Canada assesses the amount of private finance mobilized on an activity-level basis and to report on private finance associated with activities where there is a clear causal link between a public intervention and private finance and where the activity would not have moved forward, in the absence of Canada's intervention.

Double counting is avoided across private finance estimated given the third-party verification role played by the OECD-DAC. Amounts mobilised are reviewed by the OECD-DAC at the project level to ensure there is no double counting. Private finance mobilised is attributed to all official actors by applying the OECD-DAC methodology based risk, role, and amount contributed.

49 For more information on the TWG methodology please visit: http://www.oecd.org/env/cc/OECD-CPI-Climate-Finance-Report.pdf, Annex F