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Long-Term Fiscal Cost of Major Economic Investment Tax Credits

OFFICE OF THE PARLIAMENTARY BUDGET OFFICER
BUREAU DU DIRECTEUR PARLEMENTAIRE DU BUDGET

The Parliamentary Budget Officer (PBO) supports Parliament by providing economic and financial analysis for the purposes of raising the quality of parliamentary debate and promoting greater budget transparency and accountability.

The PBO recently published the five-year costs of five of the new federal investment tax credits (ITC) which target investments in the clean energy and technology sectors. Following these publications, we received requests from parliamentarians to analyze the long-term cost of these ITCs. This report presents a long-term analysis of the six tax credits using the Canada Energy Regulator's 2023 Canada Net-Zero Scenario as the baseline for our projections.

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Highlights

The Parliamentary Budget Officer (PBO) projects total fiscal costs of $103 billion over 2022-23 to 2034-35 for the six investment tax credits (ITC) in the clean energy and technology sectors: 1) carbon, capture, utilization, and storage (CCUS); 2) clean technology; 3) clean electricity; 4) clean hydrogen; 5) clean technology manufacturing; and, 6) electric vehicle (EV) supply chain.

PBO estimates that almost half a trillion dollars in investment could be eligible for these six ITCs. This is equivalent to an average annual investment of $40 billion from 2023-24 to 2034-35. We estimate that most of this investment will be used to increase electricity production from renewable sources.

PBO cost estimates are $10 billion higher compared to Budget 2024 estimates. The difference is mostly attributable to higher projected eligible investments in the electricity generation sector as it aims to achieve decarbonization by 2035.

According to data received by the PBO, hydrogen production could reach 5.9 megatonnes (MT) by 2035, which exceeds the estimated production under the Canada Net-Zero scenario as published by the Canada Energy Regulator. Similarly, based on data provided by Natural Resources Canada and Finance Canada, carbon capture could reach up to 240 MT per year by 2050, if all projects become operational. This would put Canada on track to meet the Net-zero scenario targets for CCUS.

Summary

The federal government has announced six major investment tax credits (ITC) designed to support investments in clean energy and technology:

1. Carbon Capture, Utilization, and Storage (CCUS) Investment Tax Credit (Budget 2022);
2. Clean Technology Investment Tax Credit (Fall Economic Statement 2022);
3. Clean Electricity Investment Tax Credit (Budget 2023);
4. Clean Hydrogen Investment Tax Credit (Budget 2023);
5. Clean Technology Manufacturing Investment Tax Credit (Budget 2023); and,
6. Electric Vehicle (EV) Supply Chain Investment Tax Credit (Budget 2024).

Budget 2024 estimates that these ITCs will have a fiscal cost of $93 billion over 2022-23 to 2034-35.[1]

The Parliamentary Budget Officer (PBO) recently published the five-year cost estimates of five of the ITCs.[2] This report presents a long-term analysis of these credits using the Canada Energy Regulator's (CER) 2023 Canada Net-Zero scenario as the baseline for our projections.

PBO estimates that almost half a trillion dollars in investment could be eligible for the six ITCs, with a large portion in the renewable electricity sector. PBO estimates that the six ITCs will cost $103 billion from 2022-23 to 2034-35 (Summary Table 1). The bulk of the costs are concentrated in the fiscal years beyond 2027-28.

Summary Table 1

Total cost of the investment tax credits (millions of dollars)

Investment Tax Credit	5-year Cost 2022-23 – 2027-28	Total Cost 2022-23 – 2034-35
CCUS	5,746	12,365
Clean Technology	5,207	22,300
Clean Electricity	5,359	35,599
Clean Hydrogen	5,738	18,493
Clean Manufacturing	4,503	12,816
EV Supply Chain*	5	1,095
Total Cost	**26,558**	**102,668**

Source:

Office of the Parliamentary Budget Officer, Finance Canada, Natural Resources Canada.

Note:

* The cost attributed to the EV Supply Chain comes from Budget 2024 and was not independently costed by our office.

Totals may not add due to rounding. Estimates are presented on an accrual basis. A positive number implies a deterioration in the budgetary balance.

PBO's long-term cost estimate for the six ITCs is $10 billion higher over 2022-23 to 2034-35 than Budget 2024 projections. The difference is primarily due to the higher projected eligible investments in the electricity sector. The Canada Net-Zero scenario projects large investments in nuclear power which has a higher investment cost than other renewable technologies. The Canada Net-Zero scenario also projects significant new wind power capacity over 2031 to 2035.

The project list provided by Natural Resources Canada and Finance Canada suggests that the Canada Net-Zero scenario is on track to be met for CCUS. If all projects become operational, carbon capture could reach up to 240 MT of CO_2 annually by 2050.[3] Similarly, based on project-level data provided to the PBO, hydrogen production could reach 5.9 MT by 2035, which exceeds the estimated production under the Canada Net-Zero scenario.[4]

Background

Canada's Net-Zero emissions objective

The government stated its commitment to achieve net-zero emissions by the year 2050 under the *Canadian Net-Zero Emissions Accountability Act* on November 19, 2020.[5] To ensure the attainment of the emissions reduction, the Act announced legally binding targets for each five-year milestone from 2030 to 2050 and was passed into law on June 29, 2021.[6,7] In the following year, in March 2022, the government introduced Canada's 2030 Emissions Reduction Plan which further detailed the government's medium-term climate policies and targets.[8]

Net-Zero Emissions

Net-zero GHG emissions, or carbon neutrality, refers to a state where the amount of greenhouse gases emitted into the atmosphere are counterbalanced by the amount that is removed or offset, resulting in no net increase in the concentration of such gas emissions.

The costs and mechanisms for decarbonizing the Canadian energy sector, in particular electricity production, have been studied by the Canadian Climate Institute (2022), Trottier Energy Futures Project (2016) and Dolter & Rivers (2018) among others. In June 2023, CER published Canada's Energy Future 2023 (CF2023) which includes a detailed pathway for achieving net-zero emissions in the electricity sector by 2035 and the broader energy sector by 2050.[9]

Investment tax credits

According to CF2023 and Environment and Climate Change Canada (ECCC) modelling[10], expanding electricity generation by renewable sources as well as increasing the use of biomass, hydrogen and carbon capture will be required to decarbonize the energy sector. Beginning in Budget 2022, the government announced several ITCs to incentivize the development and adoption of clean energy and technology:[11]

1. Carbon Capture, Utilization, and Storage (CCUS) Investment Tax Credit (Budget 2022);[12]
2. Clean Technology Investment Tax Credit (Fall Economic Statement 2022);[13]
3. Clean Electricity Investment Tax Credit (Budget 2023);[14]
4. Clean Hydrogen Investment Tax Credit (Budget 2023);[15]
5. Clean Technology Manufacturing Investment Tax Credit (Budget 2023);[16] and,
6. Electric Vehicle Supply Chain Investment Tax Credit (Budget 2024).[17]

Budget 2024 estimates that the six ITCs will cost $93 billion over 2022-23 to 2034-35.[18,19]

Inflation Reduction Act

The United States has also enacted significant policy measures to support clean technologies via the *Inflation Reduction Act* (IRA).[20] The IRA allocates approximately $400 billion USD toward clean energy and climate initiatives.[21] The IRA introduced clean electricity and clean manufacturing tax credits which are estimated to cost the U.S. federal government nearly $200 billion USD from 2022 to 2031.[22]

PBO's long-term cost estimates

PBO previously published five-year cost estimates for five of the ITCs. These tax credits are longer-term in nature, expiring between 2034 to 2040 and, along with other policies, support the government's broader climate objectives such as decarbonizing Canada's electricity sector by 2035 and attaining net-zero emissions by 2050. This report presents a long-term analysis of the ITCs using the CER's 2023 Canada Net-Zero scenario as the baseline for our long-term projections.

Detailed methodology for each five-year ITC costing can be found in the individual costing notes on our website.[23] The methodology used in this report is largely unchanged from previous releases.[24] We continue to assume that all provinces and eligible enterprises will meet the applicable federal policy and labour requirements to access the ITCs.

We determined that the Canada Net-Zero scenario is the most consistent with the government's climate objectives and future policy path. We provide a sensitivity analysis of our cost estimates under alternative policy scenarios in the risk section of this report.

According to Budget 2023, "The scale of investments that Canada requires to reach net-zero by 2050 is significant, with estimates ranging from $60 billion to $140 billion per year on average." PBO estimates that almost half a trillion dollars in total capital investment over 2022 to 2035 will be eligible for the six ITCs (Table 1). This represents $40 billion in annual investment, on average, over this period.

Table 1

Estimated eligible investments by tax credit from 2022-23 to 2034-35 (billions of dollars)

Investment Tax Credits	Total investment	Average annual investment
CCUS	29	2
Clean Technology	86	7
Clean Electricity	237	20
Clean Hydrogen	59	5
Clean Manufacturing	59	5
EV Supply Chain	12	1
Total Investment	**482**	**40**

Source:
Office of the Parliamentary Budget Officer, Finance Canada, Natural Resources Canada.

Note:
Totals may not add due to rounding. The cost is averaged over twelve years, between 2023-24 and 2034-35 with the exception of CCUS which begins in 2022-23.

We did not estimate the long-term economic impact of these investment tax credits. Such estimates would need to account for the interaction with other climate policies which is beyond the scope of this report. Moreover, certain investments are required to meet regulatory standards such as clean electricity generation. In this respect, the ITCs serve to reduce costs to end-users.[25]

The impact of the projected investments in clean technologies on the economic outlook is uncertain. Some investment will be offset by declines in spending on fossil fuels and other industries. PBO (2021) projected that the government's emission reduction policies would increase real GDP and investment in the electricity sector but would have a negative overall economic impact by 2030.[26] The Bank of Canada (2022) estimated that real investment would decline in Canada under various climate transition scenarios despite an increase in capital expenditures in the electricity sector.[27]

Nonetheless, emerging clean technologies have the potential to expand domestic and export markets for Canada[28] and limit the economic impact of the transition to net-zero.[29] The Canadian Climate Institute (2024) finds that while the impact of the ITCs on emissions by 2030 are relatively small, they are complementary to other policies and

potentially important for economic competitiveness and attracting long-term investment.[30]

We project that the six ITCs will cost $103 billion over 2022-23 to 2034-35 (Table 2). The fiscal impact is significantly higher for the 2029-30 to 2034-35 period due to a substantial increase in investment.

Table 2
Total cost of the investment tax credits (millions of dollars)

Investment Tax Credit	5-year Cost 2022-23 – 2027-28	Total Cost 2022-23 – 2034-35
CCUS	5,746	12,365
Clean Technology	5,207	22,300
Clean Electricity	5,359	35,599
Clean Hydrogen	5,738	18,493
Clean Manufacturing	4,503	12,816
EV Supply Chain*	5	1,095
Total Cost	**26,558**	**102,668**

Source:
Office of the Parliamentary Budget Officer, Finance Canada, Natural Resources Canada.

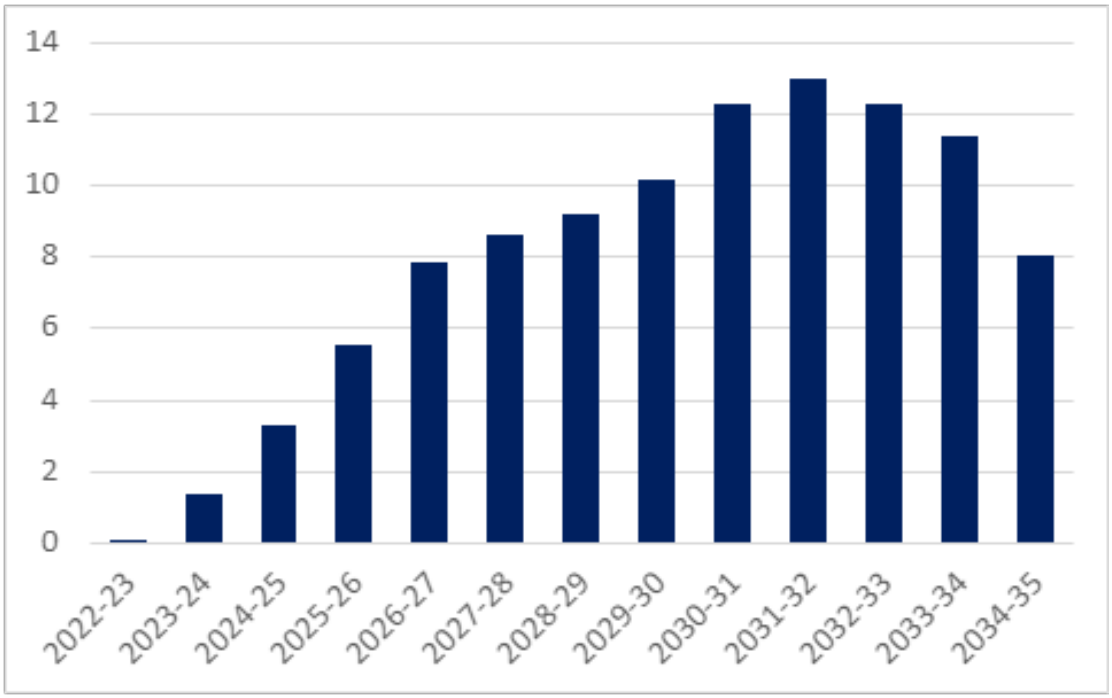
Note:
* The cost attributed to the EV Supply Chain comes from Budget 2024 and was not independently costed by our office.

PBO's estimates do not include eligible equipment related to heat generated from biomass. Totals may not add up due to rounding. Estimates are presented on an accrual basis. A positive number implies a deterioration in the budgetary balance.

The bulk of the fiscal costs are concentrated in the long-run; average annual spending is estimated to average $11.2 billion per year between 2029-30 to 2034-35 with a peak of $12.9 billion in 2031-2032 (Figure 1).

Figure 1

Annual fiscal impact of the investment tax credits (billions of dollars)



Source:
Office of the Parliamentary Budget Officer.

Notes:
Totals may not add due to rounding.

The most important cost driver of these ITCs is the pace at which emerging technologies are adopted so that the Canadian economy can transition to net-zero.[31] Another potential key source of uncertainty is interprovincial energy trade. Dolter & Rivers (2018) estimate that linking provincial electricity grids could reduce the investment costs of decarbonizing Canada's electricity grid.

Comparison with Finance Canada's cost estimates

Budget 2024 estimates that the six ITCs will cost $93 billion over 2022-23 to 2034-35.[32] PBO's long-term cost estimate of these ITCs is $10 billion higher over 2022-23 to 2034-35 than Budget 2024 projections (Table 3).

Table 3

Comparison of the PBO and Finance Canada's cost estimates from 2022-23 to 2034-35 (cost in millions of dollars)

Investment Tax Credit	Total Cost 2022-23 – 2027-28			Total Cost 2022-23 – 2034-35		
	PBO	Finance Canada	Difference	PBO	Finance Canada	Difference
CCUS	5,746	4,571	1,175	12,365	12,493	-128
Clean Technology	5,207	7,465	-2,258	22,300	17,780	4,520
Clean Electricity	5,359	5,250	109	35,599	32,275	3,324
Clean Hydrogen	5,738	5,560	178	18,493	17,670	823
Clean Manufacturing	4,503	4,575	-72	12,816	11,280	1,536
EV Supply Chain	5	5	0	1,095	1,095	0
Total Cost	**26,558**	**27,426**	**-868**	**102,668**	**92,593**	**10,075**

Source:
Office of the Parliamentary Budget Officer, Finance Canada, Natural Resources Canada.

Note:
Totals may not add due to rounding. PBO's estimates do not include eligible equipment related to heat generated from biomass.

The difference is mostly attributable to higher projected eligible investments in the electricity sector.[33] PBO's estimates are based on the Canada Net-Zero scenario which assumes that large investments in nuclear power, which have higher capital costs than other power sources, are required to decarbonize Canada's electricity grid. The Canada Net-Zero scenario also projects significant new wind power capacity over 2031 to 2035. Overall, there is considerable uncertainty about the future investment, adoption and effectiveness of new technologies.

Several factors contribute to the difference in our forecast for clean technology manufacturing. Variances may arise from undisclosed projects or confidential information within the EV supply chain ecosystem. Our forecast primarily relied on limited public announcements and historical data to estimate current and future investments.

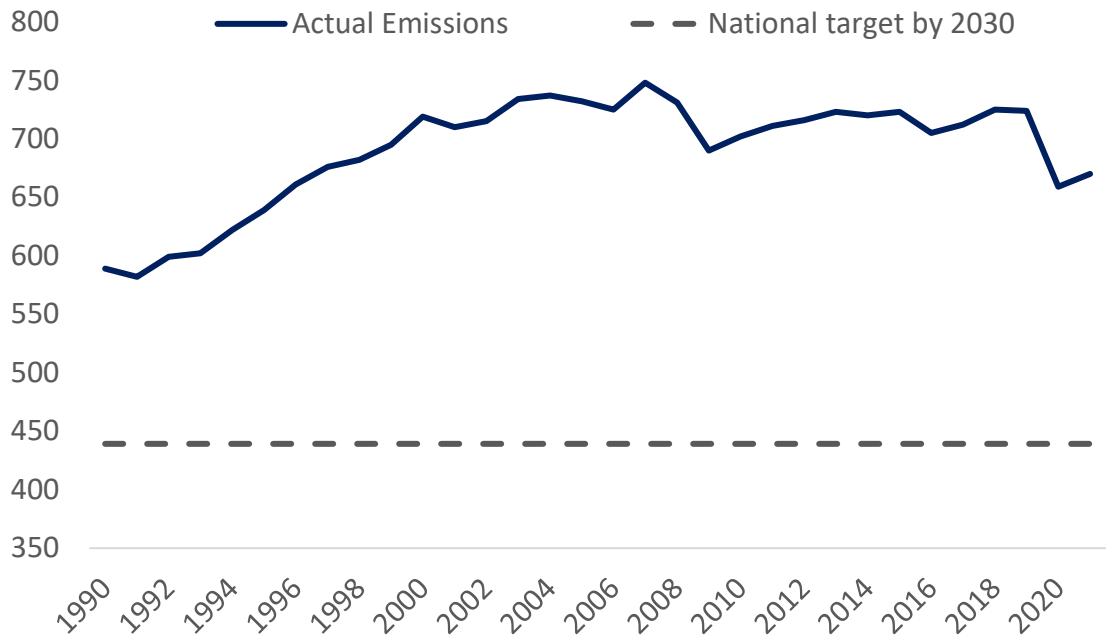
PBO's estimates of the hydrogen and CCUS ITCs are roughly in line with the government's estimates. Nonetheless, there is considerable uncertainty about the future role of these developing technologies.

Contribution to GHG reductions

The federal government has committed to achieving net-zero greenhouse gas (GHG) emissions by 2050. One of the key milestones is reducing GHG emissions by 40-45 per cent below 2005 levels by 2030.

Figure 2

Total greenhouse gas emissions (MT of carbon dioxide equivalent)



Textual description:

As of 2021, emissions are sitting at 670 MT. To reduce emissions by 40-45 per cent below 2005 levels by 2030, emissions would need to decline to approximately 440 MT. The blue line shows actual historical emissions while the dashed line indicates the 2030 emissions target.

Source:

Office of the Parliamentary Budget Officer. National inventory report.

In Budget 2021, when the government proposed the introduction of the CCUS ITC, it stated a goal of reducing emissions by at least 15 MT of CO_2 annually. The CER's Canada Net-Zero scenario projects 220 MT of CO_2 captured using CCUS by 2050.[34] Based on the current list of projects provided by Natural Resources Canada and Finance Canada, it is anticipated that the Canada Net-zero scenario is on track to be met. Based on our current projection, assuming all projects eventually become operational, carbon captured per year could reach up to 240 Mt CO_2 by 2050.[35]

When considering hydrogen production, the Canada Net-Zero scenario estimates that total production would reach 5.3 MT by 2035. Net emissions from hydrogen production are estimated to reach -1.4 MT of CO_2 by 2035.[36] Given the list of projects, the PBO estimates that production capacity could reach up to 5.9 MT by 2035.

The CF2023 estimates that GHG emissions produced by electricity generation will decline from 53.7 MT CO_2 eq in 2023 to negative 5.7 MT in 2035, thereby achieving a net-zero electricity grid by 2035.[37]

The manufacturing and EV supply chain ITCs will primarily affect GHG emissions in the transportation sector. In 2021, the transport sector was the second largest contributor to GHG emissions accounting for 150 Mt CO_2 eq, or 22 per cent of total emissions. Passenger vehicles made up 85.8 Mt CO_2 eq.[38] The CER estimates that by 2050, the transportation sector as a whole will decline to 14 Mt CO_2 eq.

Risks

We highlight specific risks to the cost of each ITC in the five-year costing notes published on our website. The fiscal risks grow progressively over time with the greatest uncertainty occurring between 2030-31 to 2034-35.[39]

The clean energy and technology sectors have made significant progress in attracting investment, but they must evolve even more rapidly to meet the government's net-zero objective. Public announcements and confidential data received mainly relate to projects that are in the early stages of planning, which contributes to the uncertainty surrounding these projects, particularly in the long-term. Moreover, due to the limited number of operational projects in Canada and worldwide in areas such as CCUS and Hydrogen, there is a persistent level of uncertainty on the timelines and future capacity. Furthermore, there exists a potential risk concerning the dependability of the supply chain and the availability of proficient trade workers to support the CCUS and Hydrogen industry.

Given the elevated levels of uncertainty, we consider the fiscal cost of the ITCs under alternative CER scenarios (Table 4).[40] Of the three scenarios, only the Canada Net-Zero scenario is estimated to achieve net-zero GHG emissions by 2050. Neither the Evolving Policies nor Current Measures scenarios achieve net-zero emissions; however, the Evolving Policies scenario achieves more emissions reduction than the Current Measures scenario.

Table 4

Fiscal cost from 2022-23 to 2034-35 of the ITCs under alternative CER scenarios (billions of dollars)

Investment Tax Credit	Canada Net Zero (PBO Baseline)	Evolving Policies (CER 2021)	Current Measures (CER 2023)
CCUS	12.4	3.0	0.9
Clean Technology	22.3	14.0	12.2
Clean Electricity	35.6	19.2	16.7
Clean Hydrogen	18.5	3.6	7.5
Clean Manufacturing*	12.8	12.9	13.1
EV Supply Chain**	1.1	1.1	1.1
Total	**102.7**	**53.8**	**51.4**

Source:
Office of the Parliamentary Budget Officer, Canada Energy Regulator, Finance Canada, Natural Resources Canada.

Note:
We consider the cost of the ITCs under three of the Canada Energy Regulator's (CER) scenarios. The three scenarios are listed in order of most emissions reduced (zero emissions of CO_2 by 2050 under the Canada Net-zero Scenario) to least emissions reduced (566 MT emissions by 2050 under the Current Measures Scenario). The Evolving Policies Scenario does not specify the total reduction in CO_2 emissions.

*The clean manufacturing ITC is anticipated to be similar across all three scenarios as the costs are mainly tied to the federal government's sales targets rather than emissions targets, so only the technological assumptions on the price of EV's are changing.

**The cost attributed to the EV Supply Chain ITC comes from Budget 2024 and was not independently costed by the PBO.

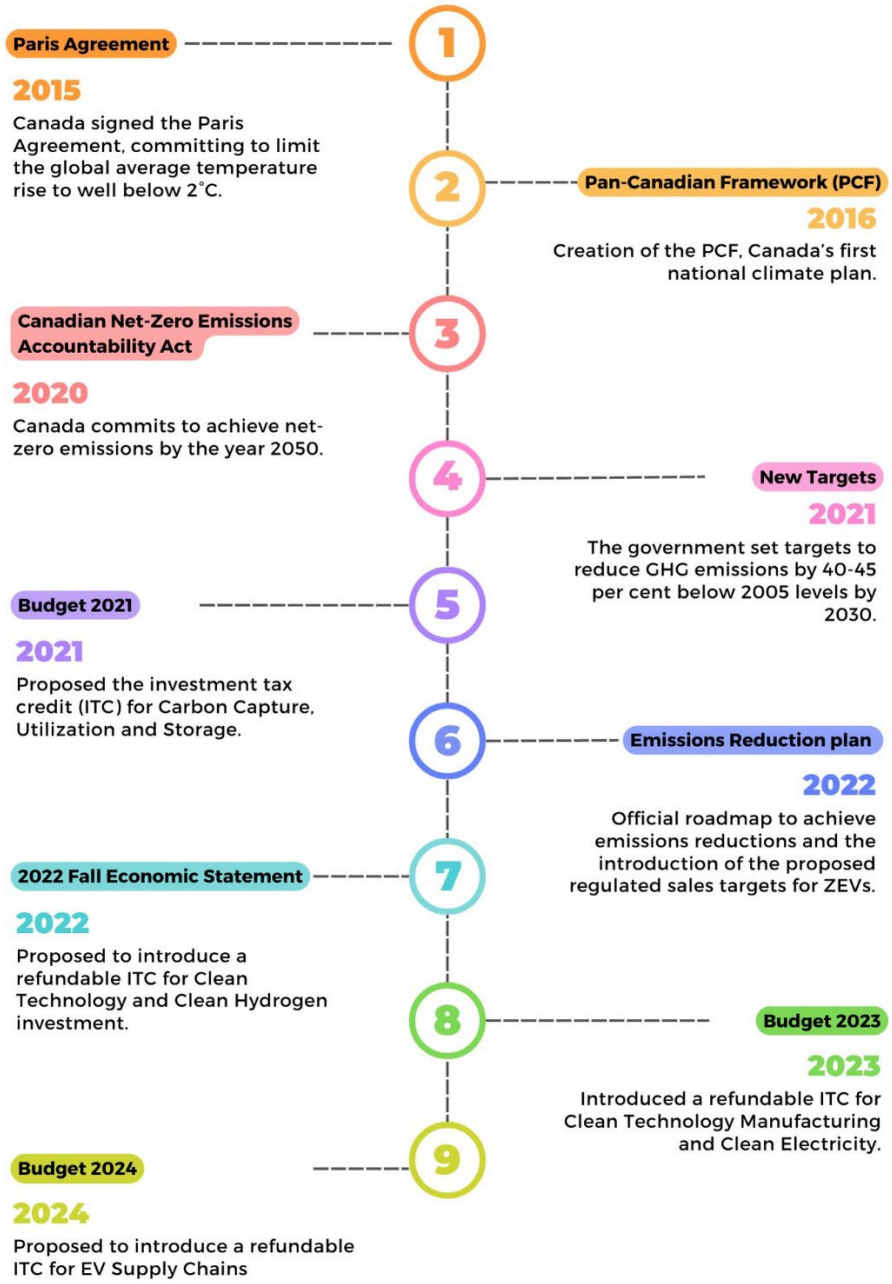
Data received for CCUS and Hydrogen consists of projects in the early stages of planning and include incomplete and/or estimated data. We assumed most projects would eventually be operational under the baseline scenario.

Capital costs for renewable technologies are anticipated to decrease in the future due to economies of scale and mass production, which could lower the future cost of the ITCs. We assume costs in line with the CER's technology assumptions.[41]

PBO will continue to monitor future developments that could have fiscal implications for Canada's transition to net zero.

Appendix A: Overview of Canada's climate policies

Figure A-1
Timeline of Climate Policies



Textual description:

This figure demonstrates the government's announcements and action on climate change. In 2015, Canada signed the Paris Agreement and the government created the Pan-Canadian Framework (PCF), Canada's first national climate plan in 2016. Then in 2020, the government announced its commitment to net-zero emissions by 2050, followed by their 2030 emissions targets announced in 2021. The announcements of the ITCs were then made including: CCUS (2021), clean technology (2022), clean hydrogen (2022), clean technology manufacturing (2023), clean electricity (2023) and EV supply chain (2024).

Notes

[1] Chapter 4: Economic Growth for Every Generation (Budget 2024).

[2] A Made-in-Canada Plan: Affordable Energy, Good Jobs, and a Growing Clean Economy.

Investment Tax Credit for Clean Hydrogen.

Investment Tax Credit for Carbon Capture, Utilization and Storage.

Investment Tax Credit for Clean Electricity.

Investment Tax Credit for Clean Technology.

Investment Tax Credit for Clean Technology Manufacturing.

[3] Data received consists of projects in the early stages of planning and have incomplete and/or estimated data. Given the relatively small number of projects currently operational in Canada and globally, inherent uncertainty persists. Furthermore, there exists a potential risk concerning the dependability of the supply chain and the availability of proficient trade workers to support the CCUS and Hydrogen industry. Delays in project timelines or the discontinuation of projects could prevent the government from achieving the necessary carbon capture targets required to meet the Canada Net-Zero scenario.

[4] Canada's Energy Future 2023: Energy Supply and Demand Projections to 2050 – Data Supplement (CER).

[5] A healthy environment and a healthy economy.

[6] CER – Canada's Energy Future 2020 - Towards Net-Zero.

[7] Government of Canada confirms ambitious new greenhouse gas emissions reduction target.

[8] Canada's climate plans and targets.

[9] Canada Energy Regulator.

[10] 2030 Emissions Reduction Plan: Clean Air, Strong Economy.

[11] These ITCs complement other measures such as a carbon levy, regulatory standards for fuels, vehicles, buildings and energy production, incentive programs to foster the adoption of clean technologies and direct spending initiatives.

[12] In Budget 2021, the government first proposed the introduction of an ITC for capital invested in carbon capture, utilization, and storage (CCUS) projects. Subsequent Budgets further specified eligibility for this tax credit.

The CCUS ITC offers a refundable tax credit between 37.5 per cent and up to 60 per cent, depending on the usage and equipment. The credit will apply to eligible expenses incurred starting on January 1st, 2022. From 2031 to 2040, the ITC rates will be halved and fully phased out after 2040.

[13] In the 2022 Fall Economic Statement, the government proposed a Clean Technology ITC equal to 30 per cent of the capital cost of eligible equipment. The credit is available for eligible property that is acquired and that becomes available for use after March 28, 2023, and is reduced in half in 2034 and phased out afterwards.

[14] In Budget 2023, the government proposed an ITC for Clean Electricity which introduced a 15 per cent refundable tax credit for eligible investments. The credit is available as of the day of Budget 2024 for projects that did not begin construction before the day of Budget 2023. The credit is to be phased out after 2034.

[15] The Clean Hydrogen ITC, first announced in the 2022 Fall Economic Statement and described in Budget 2023, provides a 15 to 40 per cent refundable tax credit for investments in projects that produce all, or substantially all, hydrogen through their production process. This credit applies to property acquired and that becomes available for use on or after March 28, 2023, and is reduced in half in 2034 and phased out afterwards.

[16] Budget 2023 proposed to introduce a refundable investment tax credit for Clean Technology Manufacturing equal to 30 per cent of the capital cost of eligible property associated with eligible activities.

The credit would apply to property that is acquired and becomes available for use on or after January 1st, 2024, subject to a phase out starting in 2032 and ending in 2034.

[17] Chapter 4: Economic Growth for Every Generation (Budget 2024).

[18] Economic and Fiscal Overview (Budget 2024).

[19] This amount does not include the special contribution agreements to support EV battery manufacturing by Northvolt, Volkswagen and Stellantis-LGES which includes $37.7 billion in support. Support for EV battery manufacturing – Update on foregone CIT revenue.

The Investment Tax Credit for Clean Technology Manufacturing is not available for property used in the production of battery cells or modules if such production benefits from direct support through a Special Contribution Agreement with the Government of Canada. Announced support to date for Northvolt, Volkswagen and Stellantis-LGES includes production subsidies of $32.8 billion and construction support of $4.9 billion. Costing Support for EV Battery Manufacturing.

[20] Inflation Reduction Act Guidebook (The White House).

[21] Estimated Budgetary Effects of Public Law 117-169, to Provide for Reconciliation Pursuant to Title II of S. Con. Res. 14 (Congressional Budget Office).

[22] CBO Scores IRA with $238 Billion of Deficit Reduction-2022-09-07.

[23] PBO has not produced an independent cost estimate of The Electric Vehicle Supply Chain Investment Tax Credit, which was introduced in Budget 2024.

Investment Tax Credit for Clean Hydrogen.

Investment Tax Credit for Carbon Capture, Utilization and Storage.

Investment Tax Credit for Clean Electricity.

Investment Tax Credit for Clean Technology.

Investment Tax Credit for Clean Technology Manufacturing.

[24] Major projects announced since our publication were added for clean technology manufacturing. This includes, but is not limited to, a more comprehensive list of investment across the EV supply chain. Additionally, some adjustments were made to our analysis for other clean technology to better align with more up-to-date information.

Honda to build Canada's first comprehensive electric vehicle supply chain, creating thousands of new jobs in Ontario (Prime Minister of Canada).

[25] Regulatory standards apply to clean fuels, electricity and electric vehicles. Budget 2024 indicates that the clean electricity ITC will require provincial authorities to commit to net zero objectives and to pass savings on to rate payers.

[26] Beyond Paris: Reducing Canada's GHG Emissions by 2030.

[27] Publication of the Bank of Canada.

[28] CF2023 projects that Canada will export 5 MT of Hydrogen under its Global Net-Zero scenario.

[29] Shapiro & Metcalf (2021) find that introducing firm creation and green technological adoption dynamics can materially limit the adverse economic impacts of carbon pricing.

[30] Data-driven insights from the Canadian Climate Institute.

[31] For example, if Canada's future electricity grid is powered by a higher share of nuclear, a relatively more expensive technology compared to wind and solar, this could increase the investment and fiscal costs of the net zero transition. Lazard (2023) provides a detailed analysis of the levelized cost of energy from various technologies.

[32] Economic and Fiscal Overview (Budget 2024).

[33] Another potential difference could be the impact of other government support for equipment eligible for the ITCs. Our estimates account for future investments by the Canada Infrastructure Bank and the Smart Renewables and Electrification Pathways Program. We do not incorporate the Canada Growth Fund as we are unable to clearly allocate this funding across the different ITCs.

[34] Canada's Energy Future 2023: Energy Supply and Demand Projections to 2050 – Data Supplement (CER).

[35] This includes non-eligible investments for the CCUS ITC. For instance, it includes CCUS capture from Ontario which is not an eligible jurisdiction for the CCUS ITC. Additionally, it includes CCUS investment that became operational before the ITC came into effect such as the Alberta Carbon Trunk Line (ACTL).

[36] By 2035, the CER estimates net emissions from hydrogen production could be -1.4 MT of CO2 eq. in 2035 and -25.10 MT of CO2 eq by 2050.

Hydrogen Production (CER).

[37] CF2023 modelling shows that bioenergy combined with carbon capture and storage enables net-negative GHG emissions from electricity generation by producing energy for the grid and permanently storing carbon.

[38] Greenhouse gas emissions.

Report 8 — The Zero Emission Vehicle Infrastructure Program - Natural Resources Canada.

[39] Canada's emission reduction plan provides a detailed policy framework that extends to 2030. After this time, CF2023 modelling assumptions ensure Canada achieves its net zero targets.

[40] Under the evolving policies scenario, hydrogen production is estimated to be one-fifth of the production under the net-zero scenario, whereas under the current measures scenario, hydrogen production is about two-fifths of the net-zero scenario. Therefore, the evolving policies scenario would imply that almost all projects would not be commissioned. Under the current measures scenario, this would be equivalent to only projects that are in development being commissioned and all other projects being abandoned.

For CCUS, the emissions reduction under the current measures scenario is approximately 33 Mt CO_2 eq by 2050. Currently, for projects operating and under construction, there is an annual target of nearly 21 Mt CO_2 to be captured once full capacity is reached. Therefore, most projects submitted would not successfully be commissioned under this scenario.

We use emission targets to estimate the cost under the different scenarios. As the clean manufacturing and EV supply chain ITCs do not have specific emission targets, it is hard to estimate the cost under the different scenarios. Overall, we anticipate the cost to be similar across all three scenarios as they are mainly tied to the federal government's sales targets.

[41] Technological assumptions used can be found in Table A.2. published in the CER's Canada Energy Future 2023 report. Canada's Energy Future 2023: CER's first long-term Outlook modeling Net-Zero by 2050 (CER).

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