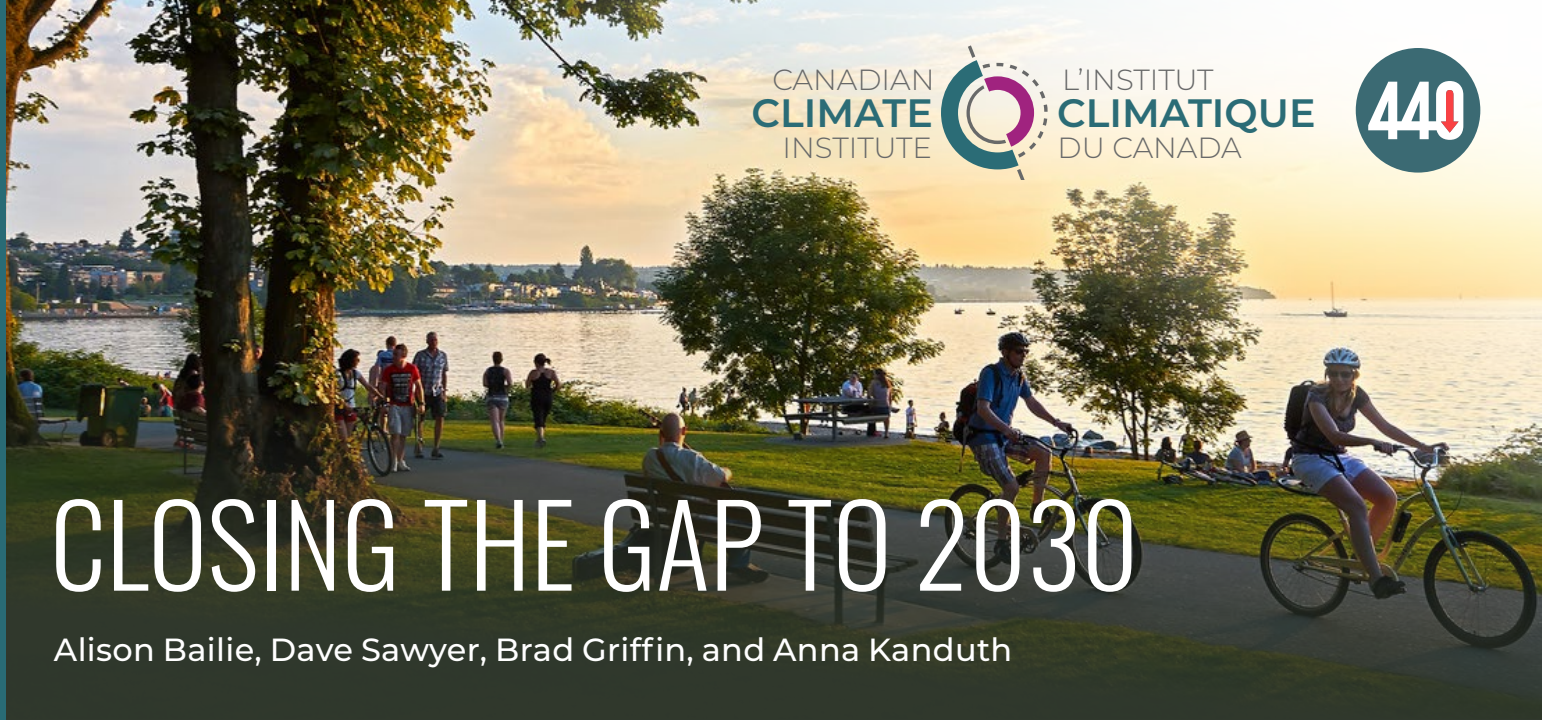
TECHNICAL ANNEX



CANADIAN CLIMATE INSTITUTE | L'INSTITUT CLIMATIQUE DU CANADA

CLOSING THE GAP TO 2030

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Context

The Net-Zero Advisory Body (NZAB) commissioned the Canadian Climate Institute to identify policy options to close the gap between expected emissions under policies announced in the 2023 Progress Report on the 2030 Emissions Reduction Plan (ERP-PR) and Canada's 2030 target of 40 to 45 per cent below 2005.

Approach

Previous analysis from the Institute, in partnership with Navius Research, projected that net greenhouse gas (GHG) emissions would decline by 34 to 36 per cent below 2005 levels in 2030, if governments implement all legislated, developing, and announced climate policies reported in the ERP-PR. For this project, we again worked with Navius Research on new modelling and analysis to identify a suite of policies the federal government could implement to close the gap to Canada's 2030 target.

We completed the following steps:

1. **Identified and modelled potential policies to close the gap** We first modelled a backcasting scenario that identified the sectors and end-uses with the most economically efficient reductions to meet the 2030 target.[1] We then identified policies to test that could capture these reductions, including strengthening existing policies or applying new ones. We developed two initial policy packages to test. The modelling showed these packages did not meet the 2030 emissions reduction target. We then revised the policy parameters and developed three additional policy packages, again using the backcasting scenario results as guidance. Each of these policy packages met the 2030 emissions reduction target. Based on this modelling, we identified the following eleven policy options:

1 For this scenario, we used an economy-wide cap and trade system, which is designed to be policy agnostic, but required assumptions on implementation such as revenue recycling and free allocations under the emissions cap.

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Strengthen existing policies to drive additional emissions reductions

By existing policies we refer to those described in the ERP-PR. The details on potential policy changes that we tested are in the sub-sections below.

1. Increase the stringency of benchmarks (performance standards) in the large-emitter trading systems (LETS)[2]
2. Strengthen carbon contracts for difference (CCfDs)
3. Increase the coverage and stringency of methane regulations in the oil and gas sector
4. Increase the coverage and stringency of the oil and gas emissions cap
5. Increase the stringency of the Clean Fuel Regulations
6. Increase tax credits for clean technology
7. Increase the funding envelope of the Net Zero Accelerator Initiative and the Clean Fuels Fund

Pursue new policies to close the gap: These policies are either not in the ERP-PR or were not sufficiently defined in that report.

1. Increase the stringency of the announced medium- and heavy-duty vehicle standard
2. Introduce efficiency mandates for low-temperature industrial heat
3. Require all new and replacement heating systems to be non-emitting in residential and commercial buildings
4. Introduce a national renewable natural gas (RNG) and hydrogen blending rate

2. **Assessed priority policies.** We evaluated the strengths and weaknesses of the eleven policy options along six dimensions:

- **Effectiveness:** To what extent does the policy drive the desired change in emissions reductions or technology adoption?
- **Cost-effectiveness:** To what extent does the policy achieve emissions reductions at lowest cost?
- **Implementation (ease or risk):** How quickly or easily can a policy be put in place?
- **Technological feasibility:** To what extent are the necessary technologies to comply with the policy commercially available?
- **Competitiveness:** To what extent is the policy likely to help or hinder the competitiveness of Canadian industry?
- **Affordability:** To what extent is the policy likely to increase benefits or costs for consumers, businesses, or industry?

We also identified interactions between the policies that might improve or reduce effectiveness.

3. **Provided policy opportunities for consideration.** We used both the modelling and the policy assessment to prioritize a set of policy options for the federal government to consider for meeting the 2030 target.

2 These systems vary by region and include output-based pricing (such as Alberta's TIER system) or Ontario's emissions performance standard.

Modelling

Table 1 lists the 11 policy options we modelled, including the settings used in the Institute's independent assessment of the ERP-PR and this analysis. The policy options listed in table 1 are potential changes, not recommendations. We modelled and refined these options to develop our policy opportunities described at the end of this report.

Table 1:

Description of policies modelled

Policy	Policy description and modelling assumptions in ERP-PR assessment	Potential policy changes or additions modelled in this analysis
Federal Fuel Charge	Federal fuel charge was $50/tCO$_2$e in 2022, increasing by $15/tCO$_2$e per year until it reaches $170/tCO$_2$e in 2030, not indexed to inflation.	Index the carbon price to inflation.
Large emitter trading systems (LETS)	Federal, provincial and territorial LETS are modelled as currently legislated including emissions and sources covered, the level of the performance standards, and tightening of benchmarks between now and 2030. Revenue is recycled consistent with each LETS system. The ERP-PR modelling indicated that the carbon price does not always hold in each jurisdiction due to policy interactions.	Tighten the LETS benchmarks used to provide free allocations to industries to account for policy interactions. Index the carbon price to inflation.
Carbon contracts for differences (CCfDs)	CCfDs were not simulated.	Significantly scale up CCfDs. This is simulated in the model by tightening the LETS benchmarks used to provide free allocations to industries, providing the full price signal for investment decisions.
Oil and gas emissions cap	A regulatory framework for the emissions cap was released in December 2023 but the policy has not yet been implemented. The proposed framework is a national emissions cap-and-trade system covering direct and indirect emissions from upstream oil and gas and liquid natural gas facilities, including methane emissions.	Increase coverage to include all oil and gas categories (downstream added: refineries, natural gas distribution, and transmission of oil, natural gas and CO_2) and set the cap level to match the economically efficient reductions, accounting for larger coverage.
Clean Fuel Regulations	Require gasoline and diesel suppliers to reduce the carbon intensity (CI) of fuels used for transportation. Compliance credits include: reducing upstream emissions from liquid fossil fuel production, blending low-carbon fuels, end-use fuel switching in transport, and supply of low-carbon gaseous fuels (with some limitations).	Limit the current credit options in order to reduce interactions with other climate policies, such as net zero vehicle mandates, OR Increase the stringency of the CI reduction requirement.
Tax credits	Investment tax credits (ITC) are provided for Carbon Capture Utilization and Storage (CCUS), Direct Air Capture (DAC), hydrogen production, clean technology, and low-carbon electricity.	ITCs increased to 60 per cent for CCUS, 50 per cent for the clean technology, 30 per cent for low-carbon hydrogen, 50 per cent for clean electricity taxable entities and 25 per cent for clean electricity non-taxable entities.

Policy	Policy description and modelling assumptions in ERP-PR assessment	Potential policy changes or additions modelled in this analysis
Medium- and heavy-duty vehicle (MHDV) emissions standard	The federal government has not yet implemented their announced MHDV emissions standard. Our modelling is based on California's regulations and assumes a Zero Emission Vehicle (ZEV) sales mandate of 30 per cent of heavy-duty vehicles and 50 per cent of medium-duty vehicles in 2030.	Increase the minimum ZEV mandate for heavy- and medium-duty vehicles sales to 50 per cent for heavy-duty and 60 per cent for medium-duty vehicles sales by 2030.
National Net-Zero Building Strategy	Require new or replacement oil and gas heating systems in residential and commercial buildings to be non-emitting this decade.[3]	Require new or replacement oil and gas heating systems in residential and commercial buildings to be non-emitting this decade.
Efficiency mandate for low temperature industrial heat	None	New industrial low-temperature heat technologies are required to use heat from waste products, electric resistance, or be >100 per cent efficient.
Regulated reduction in oil and gas methane emissions	The federal government recently published proposed regulations that seek to reduce methane emissions from the upstream oil and gas sector by at least 75 per cent below 2012 levels by 2030.	Increase the reduction requirement to between 78 and 85 per cent.
Renewable natural gas blending mandate	Legislated regulatory policy exists for Quebec only (rising to 10 per cent by volume in 2030).	Require a 10 to 15 per cent volumetric blending rate with natural gas by 2030 to be met by RNG or hydrogen in each province, except where natural gas consumption is small or supply is constrained.
Net Zero Accelerator and Clean Fuels Fund	The federal government has allocated $8 billion to the Net Zero Accelerator and $1.5 billion to the Clean Fuels Fund	Provide an additional $4 billion to the Net Zero Accelerator and $750 million to the Clean Fuels Fund

We developed five scenarios, using different combinations and stringencies of policies, to explore whether the potential policy changes could close the gap to the 2030 target (table 2).

3 At the time of the analysis, the Green Building Strategy had not been released and an illustrative representation reflecting the government's mandate to implement regulatory standards to transition heating systems away from fossil fuels was used. The Green Building Strategy has now been released and is less stringent than the assumptions used in the Institute's independent assessment of the ERP-PR.

Table 2:

Policies and adjustments in each scenario

		First iteration modelling		Second iteration modelling		
Policy	Previous ERP -PR modelling	Policy Package 1	Policy Package 2	Policy Package 3	Policy Package 4	Policy Package 5
Federal Fuel Charge	✓	✓	✓	↑	↑	↑
Large Emitter Trading Systems (LETS)	✓	aim for binding price by tighter benchmarks		↑ carbon price and aim for binding price		
Oil and gas emissions cap	✓	↑	↑	↑	↑	↑
Clean Fuel Regulations	✓	↑	✓	↑↑	↑↑	↑↑
Investment Tax Credits	✓	✓	↑	↑	↑	↑
Medium and heavy vehicle emissions standard	✓	✓	↑	↑	↑	✓
Efficiency mandate for low-temperature industrial heat	×	×	✓	✓	✓	×
Regulated reduction in oil and gas methane emissions	✓	↑	↑	↑↑	↑	↑
RNG/H2 blending mandate	×	×	✓	↑	✓	✓
Net Zero Accelerator and Clean Fuels Fund	✓	✓	✓	↑	✓	✓
Light vehicle GHG standard	✓	✓	✓	✓	✓	✓
National Net-Zero Building Strategy	✓	✓	✓	✓	✓	✓
Waste methane capture	✓	✓	✓	✓	✓	✓
Canada Infrastructure Bank spending	✓	✓	✓	✓	✓	✓
Clean Electricity Regulations	✓	✓	✓	✓	✓	✓

Notes:

- ✓ the policy is applied using the ERP-PR policy design and stringency
- × the policy is not applied
- ↑ the policy is applied with greater stringency than the ERP-PR
- ↑↑ the policy is applied with much greater stringency than the ERP-PR

Previous ERP-PR modelling refers to the Announced Less Stringent scenario from the Institute's previous analysis.
The modeling simulates all major provincial and federal legislated policies with Table 2 showing only key climate policies.
The backcasting scenario is designed to be policy agnostic and not included in this table.

Canada's 2030 target is to reduce emissions by 40 to 45 per cent below 2005 levels, or to approximately 400 to 440 Mt[4]. Our modelling found that Canada's 2030 target is achievable. While our first iteration of policy packages did not meet the target, the three policy packages in the second round of modelling succeeded (table 3). Freight transport, electricity, and heavy industry account for the majority of the emissions reductions, relative to ERP-PR scenario. As shown in tables 1 and 2 above, the policy packages we modelled would require the federal government to implement stringent policy beyond what is currently in place or proposed.

4 Based Environment and Climate Change Canada's National Inventory Report, 2023.

Table 3:

Emissions by sector in 2030 (Mt CO_2e), by scenario

			First modelling iteration		Second modelling iteration		
Sector	Previous ERP-PR modelling	Backcasting* to meet 2030 target	Policy Package 1	Policy Package 2	Policy Package 3	Policy Package 4	Policy Package 5
Oil and Gas	**152**	**144**	**144**	**144**	**144**	**144**	144
Electricity	**26**	**4**	**9**	**9**	**7**	**7**	7
Transportation	**132**	**104**	**130**	**131**	**110**	**110**	111
Passenger Transport	80	76	79	80	77	77	77
Freight Transport	41	17	41	41	22	23	23
Other Transport: Recreational, Commercial and Residential	11	11	10	11	10	10	10
Heavy Industry	**73**	**55**	**71**	**66**	**59**	**61**	62
Buildings	**68**	**76**	**68**	**66**	**61**	**64**	64
Agriculture, Waste, & Forest Resources	**76**	**73**	**73**	**67**	**63**	**63**	63
Light Manufacturing, Construction & Coal Production	**26**	**16**	**27**	**23**	**16**	**17**	19
TOTAL MODELLED GHG EMISSIONS	**552**	**472**	**522**	**506**	**459**	**466**	470
Non-modelled GHG emissions							
Accounting contribution by LULUCF	-32	-32	-32	-32	-32	-32	-32
Nature-based climate solutions and agricultural soils	-13	n/a	n/a	n/a	n/a	n/a	n/a
Oil and gas cap flexibilities	-25	n/a	n/a	n/a	n/a	n/a	n/a
TOTAL NET GHG EMISSIONS**	**482**	**440**	**490**	**474**	**427**	**434**	438

Notes: * The backcasting scenario is designed to meet the emissions target in 2030 through economically efficient reductions and does not represent policies.

** NZAB requested that we assume a lower level of net emissions reductions in 2030 than in our previous analysis of the ERP-PR. For this analysis we excluded 38 Mt of potential reductions (13 $MtCO_2e$ from nature-based climate solutions and agricultural soils and 25 Mt of reduction credits from compliance flexibilities in the proposed oil and gas emissions cap). NZAB requested these 38 Mt of potential emissions reductions be excluded due to their higher degree of uncertainty. We include the land use, land-use change and forestry (LULUCF) accounting contribution of 32 Mt reduction using the same assumption as in the ERP-PR.

Modelling caveats and exogenous assumptions

- **National Inventory Report**—The modelling was completed in March 2024 and does not include the 2024 updates to the National Inventory Report (NIR).
- **Green Building Strategy**—At the time of the analysis, the Green Building Strategy had not yet been released and an illustrative representation reflecting the government's mandate to implement regulatory standards to transition heating systems away from fossil fuels was used. The Green Building Strategy has now been released and is less stringent than the assumptions used in the Institute's independent assessment of the ERP-PR. This means that the gap to 2030 will be larger than was found in the Institute's independent assessment.
- **Global Warming Potential (GWP)**—The model is calibrated to the 2023 NIR which uses GWP values from the IPCC Fourth Assessment Report (AR4) with the 100 year timeframe, as stipulated for inventory reporting under the United Nations Framework Convention on Climate Change (Table 4).

Table 4:

Global Warming Potential from the Intergovernmental Panel on Climate Change (IPCC)

	100 year timeframe			20 year timeframe		
	AR4	AR5	AR6	AR4	AR5	AR6
Carbon dioxide	1	1	1	1	1	1
Methane	25	28	27.9	72	84	81.2
Nitrous Oxide	298	265	273	289	264	273

Source: IPCC Assessment reports

- **Federal fuel charge and carbon price in LETS**—Foresight over how the carbon price will change in future years is represented over a five-year period but not longer. Decisions from 2026 to 2030 mostly use the 2030 carbon price ($170/t) even when equipment will last longer than 5 years. However, the carbon price is currently not scheduled to increase above $170/t after 2030.
- **LETS**—The model parameters for industry benchmarks (free allocations) were revised for the policy scenarios with the goal of keeping the carbon price binding. The modelling for ERP policies uses the provinces' industry-specific benchmarks, including distinction for trade exposure variance. Under the policy scenarios, benchmarks by industry were adjusted to ensure the binding carbon price in each province. Due to time constraints, for each province the same factor for adjusting benchmarks was used across all industries. This means that the tightening of industry benchmarks used to close the gap may differ slightly from stated provincial objectives.

- **Methane regulations for the oil and gas sector**—While Navius regularly updates its database of technologies, the technologies and processes for detection and capturing methane are also rapidly changing. In our policy scenarios, the model hit a maximum of 78 per cent reduction of methane below 2012 levels by 2030 due to the model's current technology specification. Achieving an 85 per cent reduction below 2012 levels by 2030 therefore required the maximum uptake of methane abatement technologies and management actions represented in the model, as well as forced production declines. However, we expect that in practice deeper reductions could be achieved by additional, emerging technology uptake (e.g., use of satellite images to detect methane leaks).
- **Clean Fuel Regulations**—The modeling analysis explicitly simulates CFR credit demand and credit generation through the three compliance streams (upstream reductions through deployment of carbon capture and storage, biofuel blending, fuel switching) as well as the resulting credit trading price. Due to the variety of actions that fall under the generic quantification method, this pathway was not explicitly simulated. Instead we assumed that generic quantification credits will be generated up to the 10 per cent limit by 2030. These credits, about 2.9 Mt of credits in 2030, are assumed to be non-incremental due to policy overlap and the difficulty in ensuring 'additionality' for actions such as efficiency improvements. Key uncertainty in the future CFR market stems from the share of home charging that will be adequately sub-metered to generate CFR credits prior to 2031, when home charging is beginning to be phased out as a compliance pathway. This analysis bases this number on ECCC's estimate in the CFR Canada Gazette Part II Regulatory Impact Analysis that about 10 per cent of light-duty vehicle home charging will be adequately metered to generate credits under the CFR. This number is uncertain; a higher rate of sufficiently metered home charging could, on its own, satisfy the entire CFR credit market demand.
- **Investment tax credits**—Simulating ITCs in the model has added uncertainty, relative to other policies, because credits vary depending on timing and type of entity purchasing.
- **Western Climate Initiative**—While the Western Climate Initiative (California and Quebec's cap and trade system) is explicitly represented in the model, the notional impact of net traded emission credits was excluded from this analysis (i.e., Quebec's 'real' GHG emissions are used not accounting for 'imported' reductions from California or 'exported' reductions to California). In the ERP-PR, the federal government assumed less than 1 Mt of additional reductions through net imported credits from this program in 2030.
- **Emissions reduction by policy**—For this analysis, policy packages rather than individual policies were simulated. Subsequently, emission reductions cannot be attributed to individual policies in this analysis.
- **Land use, land-use change and forestry (LULUCF)**—LULUCF captures the net emissions contribution of forest lands, cropland, grassland, wetland, settlements, other land and harvested wood products using the sub-sector projections that were available as reported by the Government of Canada in Table A.43 of Greenhouse gas and air pollutant emissions projections – 2023. The value from the Government of Canada's projections (32 Mt CO_2e removed) is used in all scenarios.

Multi-criteria policy assessment

Each of the 11 policies we modelled is assessed below using our six assessment criteria (Step 2 above). Our definitions for current policy status are based on Navius Research's Assumptions report for our Independent Assessment of the ERP-PR.

1. Increase the stringency of benchmarks (performance standards) in the large-emitter trading systems (LETS)

Policy	Sectors	Current policy status	Policy change to close the gap
Large-emitter trading systems (LETS)	**Heavy industry, oil and gas, electricity**	**Legislated:** Provinces or territories that develop their own LETS have designed their systems to meet minimum national standards including stringency requirements, such as maintaining a price signal to emitters that is equivalent to the federal carbon price ($80/t$CO_2$e in 2024, rising to $170/t$CO_2$e in 2030). Policy interactions and generous benchmarks risk an erosion of the carbon price in some provincial systems.	In advance of 2027, when new federal benchmark (minimum national standards) criteria will be applied, the federal government could signal that provincial and territorial systems will be measured against a higher standard including: ▸ tighter benchmarks to avoid excess credit creation and ensure the carbon price binds, ▸ tighter electricity benchmarks to remove all free allocations by a future date, with revenues recycled to ratepayers, and ▸ indexing the carbon price to inflation.
Strengths	▸ Cost-effectiveness: Through tightening the benchmarks, the risk that the carbon price will not hold in all provinces and territories is lessened, sending a uniform and cost-effective price signal. Tightened benchmarks and indexing to inflation reduce more emissions through a higher cost signal. ▸ Implementation: Regulatory amendments are the main changes needed, which are less onerous than new regulations. ▸ Competitiveness: LETS are designed to protect the competitiveness of large, trade-exposed emitters while also maintaining the incentive to reduce emissions. Competitiveness impacts can be monitored to ensure costs do not result in adverse impacts.		
Weaknesses	▸ Implementation: The federal government will need to consult with provinces and territories regarding changes and all governments will need to communicate the timing of possible benchmark revisions well in advance. Currently, provinces and territories are not required to implement benchmarks aligned with the federal LETS (OBPS) by industry, and the electricity sector is an example of large differences across regions. This policy change may require the federal government to assess relative stringency across provincial and territorial LETS by industry. ▸ Affordability: If free allocations are phased out in the electricity sector and the revenues from carbon pricing are not recycled to ratepayers as we suggest above, there is potential for a negative impact on affordability.		
Interactions	▸ Investment tax credits, subsidy programs, and regulations, such as the proposed Clean Electricity Regulations and proposed oil and gas emissions cap, may erode the LETS price signal through excess credit generation. Consistently monitoring credit creation and adjusting the benchmarks would help address these negative interactions. ▸ A strengthened approach to LETS benchmarks for the electricity sector could help unlock more cost-effective abatement in the sector on the road to 2035 and support timely achievement of the requirements of the proposed Clean Electricity Regulations.		

2. Strengthen carbon contracts for difference

Policy	Sectors	Current policy status	Policy change to close the gap
Carbon contracts for differences (CCfDs)	**Heavy industry, oil and gas, electricity (LETS facilities)**	**Legislated:** Federal and provincial or territorial governments can implement CCfDs now but currently these are not widespread.[5]	Significantly scale up CCfDs to support confidence in future LETS credit market prices.
Strengths	▸ Effectiveness: CCfDs can help carbon pricing deliver more emission reductions through greater certainty in future carbon prices. ▸ Competitiveness: Creating greater certainty for credit market prices through CCfDs will help attract investment for clean growth and low-carbon projects, helping Canada compete with funding from the U.S. Inflation Reduction Act (IRA). ▸ Cost-effectiveness: CCfDs can drive investment in clean growth projects at a much lower cost than direct subsidies. If LETS benchmarks are sufficiently stringent, CCfDs could come at little to no cost to governments.		
Weaknesses	▸ Implementation risk: Depending on how they are implemented, CCfDs could require case-by-case assessments of projects, which can be complicated and time-intensive. Broad, widely applicable CCfDs have not yet been applied, but may have implementation challenges since governments are required to track contingent liability.		
Interactions	▸ CCfDs can address the risk of negative policy interactions between LETS and subsidies or regulations.		

3. Increase the stringency of methane regulations in the oil and gas sector

Policy	Sectors	Current policy status	Policy change to close the gap
Methane regulations in the upstream oil and gas sector	**Oil and gas**	**Developing regulation:** The federal government published proposed regulations to reduce methane emissions from the oil and gas sector by at least 75 per cent below 2012 levels by 2030.	Increase the reduction requirement to between 78 and 85 per cent below 2012 levels by 2030.
Strengths	▸ Implementation: This policy change does not require new regulations, only adjustments to existing ones that already have refinements in development. ▸ Technological feasibility and cost-effectiveness: Solutions are commercially available and include some of the most cost-effective ways to reduce emissions in the oil and gas sector, and the economy more broadly. ▸ Competitiveness: As jurisdictions around the world explore methane intensity limits on oil and gas imports, methane regulations could help protect market access for Canadian oil and gas companies. ▸ Effectiveness: Regulations have effectively reduced methane emissions from the conventional oil and gas sector.		
Weaknesses	▸ Cost-effectiveness: While measures to reduce methane emissions are relatively inexpensive to implement, abatement costs may rise as regulations push closer to near zero methane.		
Interactions	▸ Both the methane regulations and the oil and gas emissions cap target methane emissions from the upstream oil and gas sector.		

5 CCfDs can provide a guaranteed carbon price for investors, protecting investments if current policy interactions or future changes to legislation erode the value of mitigation credits.

4. Increase the coverage and stringency of the oil and gas emissions cap

Policy	Sectors	Current policy status	Policy change to close the gap
Oil and gas emissions cap	**Oil and gas**	**Announced policy:** A regulatory framework for the emissions cap was released in December 2023 but the policy is not yet implemented. The proposed framework is a national cap-and-trade system covering emissions (including methane) from upstream oil and gas and liquid natural gas facilities.	Increase coverage to include all oil and gas categories (add downstream: refineries, natural gas distribution, transmission of oil, natural gas and CO_2) and tighten the stringency of the cap.
Strengths	▸ Implementation: This policy change would not require new regulatory tools beyond what the federal government is already proposing, but requires quick implementation. ▸ Technological feasibility: Our analysis indicated potential for additional cost-effective reductions in the refining and transmission sectors. This coupled with the trading mechanism provided by the emissions cap means that the inclusion of the downstream sector would improve compliance flexibility. In addition, our analysis shows that reductions in methane emissions—which are relatively easy and cheap to implement—do much of the heavy lifting to comply with the cap.		
Weaknesses	▸ Cost-effectiveness: Requiring deeper emissions reductions from the oil and gas sector through a regulated cap will drive more expensive emissions reductions than increasing the carbon price across the full economy. However, the combination of the cap with ITCs for CCUS helps to lower abatement costs. ▸ Competitiveness: Higher abatement costs could hinder the industry's financial performance. However, the system is being designed as a cap on emissions, not production, which can help protect the sector's competitiveness by giving firms flexibility on how they comply.		
Interactions	▸ Both the oil and gas emissions cap and methane regulations target methane emissions from the upstream oil and gas sector. ▸ Activities to comply with the oil and gas emissions cap could also generate credits in the LETS, potentially creating a surplus of carbon credits, thereby weakening the price signal and the incentive for other LETS facilities to decarbonize. Alternatively, the oil and gas cap could continue to provide incentives for fossil fuel producers to abate emissions in a case where the LETS carbon prices fall due to weak benchmarks (i.e. overcrediting) in other industries, such as electricity. ▸ The CCUS investment tax credit lowers costs to facilities to comply with the emissions cap.		

5. Increase the stringency of the Clean Fuel Regulations

Policy	Sectors	Current policy status	Policy change to close the gap
Clean Fuel Regulations	**Road transportation**	**Legislated:** Requires liquid fossil fuel suppliers to reduce the carbon intensity (CI) of fuels by 14 gCO_2e/MJ in 2030 from a 2016 baseline intensity.	Approximately double the CI reduction requirement by 2030.
Strengths	▸ Effectiveness: Reducing the CI of liquid fossil fuels effectively reduces emissions, especially in the next decade when zero emission vehicle sales are increasing but their share of total vehicle stock is relatively low. ▸ Cost-effectiveness: The CFR is technology agnostic and fuel suppliers can generate and trade credits through several options. These two mechanisms help to keep reduction costs lower than prescriptive regulations. ▸ Competitiveness: The CFR supports additional investment for biofuel suppliers and creates growth opportunities.		
Weaknesses	▸ Affordability: The CFR can increase the overall price of fuels to users who may not have readily available alternatives to their existing fossil fuel-based vehicle.		
Interactions	▸ CFR credits potentially interact with provincial and federal policies: light-duty and heavy-duty zero emission vehicle mandates, fuel blending minimums (biofuels, renewable natural gas, and hydrogen), Clean Electricity Regulations, and the oil and gas emissions cap.		

6. Increase tax credits for clean technology

Policy	Sectors	Current policy status	Policy change to close the gap
Tax credits (CCUS, DAC, H2, Clean Technology, Clean Electricity)	**Industry, electricity, buildings, transportation**	**Legislated:** Investment tax credits (ITC) are provided for Carbon Capture Utilization and Storage (CCUS), Direct Air Capture (DAC), hydrogen production (with credits depending on carbon intensity of hydrogen produced), clean technology, and low-carbon electricity (renewable, nuclear, abated natural gas electricity generation, and storage). Credits are set at a percentage of investment costs.	Approximately double the existing ITCs, increasing to 60 per cent for CCUS, 50 per cent for clean technology, 30 per cent for low-carbon hydrogen, 50 per cent for clean electricity taxable entities, and 25 per cent for clean electricity non-taxable entities.
Strengths	▸ Implementation: Change does not require new regulations, only revising the refundable amounts for existing ITCs. ▸ Competitiveness: Funding for clean technologies helps improve the competitiveness of Canadian industries, as global markets shift to low-carbon products. These subsidies will also help Canadian firms compete for capital, especially against U.S. firms receiving IRA funding. ▸ Affordability: The ITCs will lower costs to industry to comply with other policies. By shifting a portion of electricity costs from ratepayers to taxpayers, the Clean Electricity ITC mitigates upward pressure on rates, helping maintain household incentives to electrify so that they can unlock these cost savings. Switching from fossil fuels to clean electricity can help Canadian households save money on energy costs over time. ▸ Effectiveness: These ITCs can accelerate the adoption of clean technologies and reduce emissions.		
Weaknesses	▸ Implementation: Fiscal capacity remains a challenge. ▸ Cost-effectiveness: While subsidizing industry to adopt these technologies can kick-start deployment, it is a relatively higher cost policy to incentivize emissions reductions, relative to carbon pricing and other market- or technology-based regulations.		
Interactions	▸ ITCs lower industry's compliance costs for some regulations, including the oil and gas emissions cap, the Clean Fuel Regulation, the large-emitter trading systems, and the proposed Clean Electricity Regulations. ▸ If the ITCs are too generous (for example for CCUS), industry may generate excess credits under the LETS, weakening the credit price and thereby the incentive to decarbonize. Absent a tightening of the LETS benchmarks, excess credit creation could lower the overall effectiveness of both policies.		

7. Increase the funding envelope of the Net Zero Accelerator and the Clean Fuels Fund

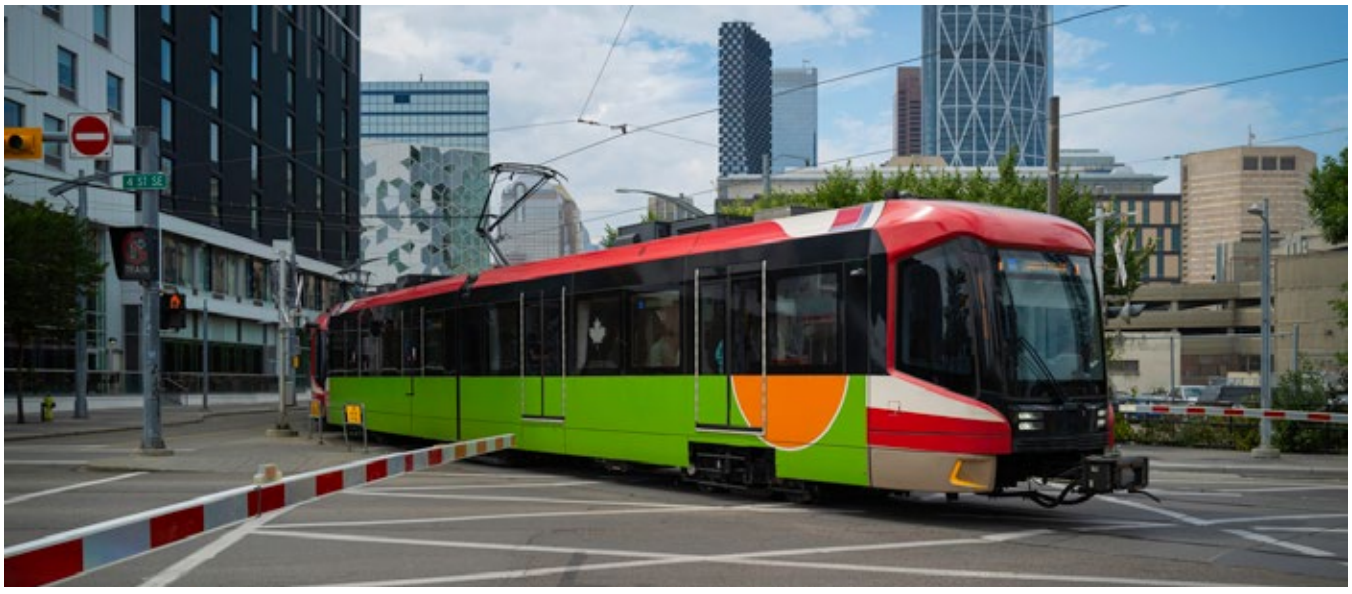
Policy	Sectors	Current policy status	Policy change to close the gap
Net Zero Accelerator Initiative and Clean Fuels Fund	**Industry**	**Legislated:** $8 billion to the Net Zero Accelerator and $1.5 billion to the Clean Fuels Fund	Significantly scale up both programs (additional $4 billion to the Net Zero Accelerator and $750 million to the Clean Fuels Fund).
Strengths	▸ Effectiveness: These programs target critical technologies necessary for the transition to net zero, including carbon capture and storage, biofuel and low-carbon hydrogen production, and industrial electrification. The Clean Fuels Fund supports the production of low-carbon liquid fuels, which our analysis suggests is a key cost-effective opportunity. The benefits of these funding programs will likely increase over time and beyond 2030 as emerging technologies scale up. ▸ Competitiveness: Lowering abatement costs helps with competitiveness, both by reducing costs for industry and by positioning Canadian low-carbon products to compete at home and abroad as the world transitions to net zero. ▸ Implementation: Scaling up current programs is straightforward.		
Weaknesses	▸ Implementation: Fiscal capacity remains a challenge. ▸ Cost effectiveness: Redirecting taxation to more subsidies has an economy-wide cost, as public funds are limited. Subsidy programs tend to be less cost-effective than the LETS to incentivise technology uptake.		
Interactions	▸ Increased funding for these programs lowers industry's compliance costs for some regulations, including the oil and gas emissions cap, the Clean Fuel Regulations, and the large-emitter trading systems. ▸ Scaling up these subsidy programs would deepen the negative interactions with the LETS and the oil and gas emission cap, exacerbating the impact of other subsidy programs. Absent a tightening of the LETS benchmarks, excess credit creation could lower the overall effectiveness of these policies by increasing supply and decreasing demand for LETS credits, undermining price signals.		

8. Require all new and replacement heating systems to be non-emitting

Policy	Sectors	Current policy status	Policy change to close the gap
National Net-Zero Building Strategy	**Buildings**	Existing federal energy efficiency regulations for heating systems. **Announced:** Green Building Strategy and exploring options to reduce the reliance on fossil fuel heating in buildings.	Require new or replacement oil and gas heating systems in residential and commercial buildings to be non-emitting.
Strengths	▸ Effectiveness: Without being technology prescriptive, this policy would force new heating systems to be non-emitting, accelerating emission reductions from the sector. ▸ Affordability: May reduce the risk of stranded assets as future emission targets tighten.		
Weaknesses	▸ Cost-effectiveness: The need for this regulation implies that the carbon price is insufficient to incentivise the switch to non-emitting furnaces, and therefore this measure is relatively costly. ▸ Affordability: This policy brings higher upfront capital costs for households but would have a longer-term payback from lower operating costs, including avoided carbon costs. In the absence of targeted government support to offset equipment expenses, low-income households would face more negative impacts due to barriers to financing for the capital costs. ▸ Implementation: The federal government would need to design and implement new regulations. The potential affordability impact could also be an implementation risk.		
Interactions	▸ Subsidies could complement this policy, particularly for low-income Canadians.		

9. Increase the stringency of the announced medium- and heavy-duty vehicle standard

Policy	Sectors	Current policy status	Policy change to close the gap
Medium and Heavy Vehicle GHG standard	**Freight transportation**	**Announced:** Plans to develop a medium- and heavy-duty vehicle (MHDV) ZEV mandate are announced but not yet implemented.	Set a minimum ZEV mandate for heavy- and medium-duty vehicles sales to 50 per cent for heavy- and 60 per cent for medium-duty vehicles sales by 2030.
Strengths	▸ Cost-effectiveness: By mandating that a rising share of new sales must be zero emissions, the MHDV standard cost-effectively creates a cross-subsidization within vehicle suppliers; they must raise prices on emitting vehicles to subsidize initially more expensive zero emission vehicles to ensure sufficient sales. The regulation avoids more costly government subsidies. ▸ Effectiveness: ZEV mandates are effective at increasing the adoption of MHDV ZEVs, in particular battery electric vehicles, which are key technologies to reduce emissions from freight transportation. While the regulations do not have a significant impact in 2030, implementing them now is important for driving emissions reductions post-2030 as the stringency ramps up and vehicle stock turns over. ▸ The U.S. EPA recently published MHDV GHG regulations for model years 2027 - 2032 that are more stringent than current regulations (which are aligned in Canada and the U.S.). This will ease implementation of more stringent (relative to current) MHDV regulations in Canada as automakers innovate to meet the U.S. mandate. The Council of the European Union recently adopted regulations for HDVs with targets of 45 per cent for the period 2030-2034, 65 per cent for 2035-2039 and 90 per cent as of 2040. The regulations also include a 90 per cent ZEV target for new urban buses by 2030, increasing to 100 per cent by 2035.		
Weaknesses	▸ Technological feasibility: The technologies for MHDV ZEVs are more uncertain and face greater barriers to deployment than light-duty ZEVs. Adoption to date has been relatively slow in Canada. Additional policies, including investment in charging infrastructure and purchase incentives, may be necessary complements to incentivize adoption. ▸ Implementation: The policy change will require the federal government to implement new regulations that are possibly more stringent than U.S. regulations if those do not advance similarly. ▸ Competitiveness: Potential risks to competitiveness if Canadian regulations are more stringent or not aligned with the U.S. EPA final rules, which do not specify minimum ZEV sales. More stringent MHDV ZEV mandates may drive up transportation costs, making it more difficult to compete with companies in other jurisdictions.		
Interactions	▸ The Clean Fuel Regulations and the fuel charge have overlapping coverage implying some risk to effectiveness.		



10. Introduce efficiency mandates for low-temperature industrial heat

Policy	Sectors	Current policy status	Policy change to close the gap
Efficiency mandate for low-temperature industrial heat	**Light manufacturing and heavy industry**	None	Require new industrial low-temperature heat technologies to use waste heat, electric resistance, or be >100 per cent efficient.
Strengths	▸ Effectiveness: Emissions reductions would occur relative to even 95 per cent efficient fossil gas heating. ▸ Cost-effectiveness: Capturing waste heat from industrial operations is already a proven cost-effective technology in cogeneration applications. Industrial heat pumps have a higher capital cost than combustion-based heating options but a lower life-cycle cost.		
Weaknesses	▸ Technological feasibility: Industrial heat pumps and other non-combustion options to supply heat at industrial scales are not yet widely available. ▸ Implementation: This change requires new energy efficiency regulations.		
Interactions	▸ Reducing fossil fuels used in industrial low-temperature heating may contribute credits under the LETS; however, given relatively low amounts of large emitter GHG emissions from low-temperature heating, the impact is expected to be small.		

11. Introduce a national Renewable Natural Gas (RNG) and hydrogen blending rate

Policy	Sectors	Current policy status	Policy change to close the gap
RNG and hydrogen blending mandate	**All**	**Legislated:** Legislated regulatory policy exists for Quebec only (rising to 10 per cent by volume in 2030)	Require a volumetric blending rate with fossil gas by 2030 of 10 to 15 per cent to be met by RNG or hydrogen in each province, except where fossil gas consumption is small or supply is constrained.
Strengths	▸ Technological feasibility: Existing fossil gas heating systems can use RNG blends, allowing emissions reductions prior to stock turnover.		
Weaknesses	▸ Effectiveness: 100 per cent blending rate with zero-carbon gaseous fuel would be needed to completely decarbonize natural gas heating systems. ▸ Implementation: The volumes of low-carbon gaseous fuel necessary to meet the blending minimum may be difficult to procure from sustainable sources within Canada or imported from other jurisdictions. Life-cycle assessment approaches, which add to the complexity of the regulation, must be used for the blending requirement to avoid high emission production methods. ▸ Cost-effectiveness: Reaching a 15 per cent minimum blending rate is likely technically possible—through second-generation biogas from non-food crops, woody biomass, or hydrogen from hydrolysis—but may be more expensive than alternatives. ▸ Affordability: Low-income groups may have difficulty accommodating increased fuel costs passed on from utilities and have limited ability to switch to alternatives like heat pumps.		
Interactions	If the RNG and hydrogen minimum blending rates are more stringent than the CFR requirements, they will generate credits, potentially reducing the CFR credit price and incentives to abate emissions. This risk is limited since the CFR caps the use of such credits.		

Policy Opportunities

Step 1 of our analysis found that achieving Canada's 2030 target of reducing emissions by between 40 and 45 per cent below 2005 levels is achievable, if governments move quickly to strengthen existing policies and introduce new stringent climate policies, such as the eleven policy options we identified. In Step 2, we assessed the eleven policies using a multi-criteria policy assessment to evaluate strengths and weaknesses along six dimensions: effectiveness, cost-effectiveness, implementation, technological feasibility, competitiveness, and affordability. This final step prioritized the policy opportunities identified through this work. We identify next steps the federal government can consider on ten of the eleven policy options. Our assessment found that the weaknesses of a potential national Renewable Natural Gas (RNG) and hydrogen blending rate exceeded its strengths.

The federal government could consider the following policy options to achieve Canada's 2030 emissions target (listed in priority order based on our assessment):

1. Follow through and legislate developing and announced policies

The government should follow through on the developing and announced policies laid out in the 2023 Progress Report on the 2030 Emissions Reduction Plan. In particular, the federal government should focus on the most critical developing and announced policies, including the proposed Clean Electricity Regulations and the oil and gas emissions cap.

2. Strengthen existing policies to drive additional emissions reductions, including by addressing counterproductive interactions

As the federal government works to implement policies on the books, it should also pursue opportunities to strengthen those policies to drive additional emissions reductions, such as through the following policy changes (ordering is based on prioritizing policies that are particularly strong on effectiveness and ease of implementation, from our assessment above):

A. Minimize interactions between several policies and the large-emitter trading systems

Recent analysis by the Canadian Climate Institute indicates some future LETS market prices don't always hold at the national carbon price, due to an oversupply of credits that erodes the trading price and significantly weakens the abatement signal. The analysis projected credit oversupply for Alberta and B.C., while LETS in other provinces are projected to avoid this issue through 2030.

Credit oversupply can happen when governments grant firms more credits than needed for compliance, when subsidies spur technology investments, and when overlapping policies double-count reduction credits. The Institute's analysis shows that addressing credit oversupply and policy overlap in all Canadian LETS can reduce economy-wide emissions by an additional 15 Mt in 2030. To do so, federal, provincial, and territorial governments could routinely monitor and update GHG benchmarks if needed to ensure credit markets func-

tion as designed. The earliest the federal government could impose new minimum national standards, including more stringent benchmarks, is 2027. Policy interactions that erode the carbon price could be addressed sooner if identified as a risk to the carbon price signal.

B. Strengthen the carbon pricing signal by scaling up carbon contracts for difference (CCfDs) and indexing the carbon price to inflation

In addition to regularly tightening benchmarks in the LETS, the federal government can also scale-up CCfDs and index the carbon price to inflation to strengthen the carbon price signal.

Scaling-up carbon contracts for difference, which insure against uncertain future carbon prices, can help maintain investment certainty. Note, if LETS are strengthened through tightened benchmarks, and this is clearly signaled for long-term investment certainty, the need for CCfDs diminishes.

Indexing the carbon price to inflation ensures that as the prices of goods and services increase in the economy, so too does the price to pollute.

C. Increase the stringency and coverage of methane regulations for the upstream oil and gas sector

Reducing methane by 75 per cent by 2030 is increasingly seen as a floor, not a ceiling, of what's possible. The federal government has already committed to exceeding this target, some of the world's largest oil and gas companies are aiming for near-zero methane emissions by 2030, and British Columbia has committed to nearly eliminate all industrial methane by 2035.

To exceed the announced target, the federal government could expand coverage to downstream emissions, including refineries, and introduce more stringent requirements, such as more frequent leak detection and repair. Governments also need to improve the measurement, reporting, and verification of methane emissions.

D. Adjust the coverage and increase the stringency of the oil and gas emissions cap

To drive additional emissions reductions from the oil and gas sector, the federal government could expand the coverage of the policy to include midstream and downstream emissions (including refineries, natural gas distribution, and oil, natural gas, and CO_2 transmission) and tighten the stringency of the cap.

In addition, while we did not model this change, the federal government could consider excluding methane emissions from the oil and gas emissions cap to address the overlap with the methane regulations in the upstream oil and gas sector.

E. Increase the stringency of the Clean Fuel Regulations

Our economy-wide cap scenario indicated that a larger share of biofuels for freight transportation is cost-effective for meeting the 2030 target. This is especially true in the next decade when zero emissions vehicle sales are increasing but their share of total vehicle stock is still relatively low.

Strengthening the Clean Fuel Regulations is one of the most direct policy changes available to target emissions from transportation fuels. Because adjustments to the regulations are set to come into force this year, this option wouldn't require new policy instruments, only amendments to the intensity tightening rate. Our policy analysis suggests that at least doubling the stringency of the Clean Fuel Regulations in 2030 could promote a substantial increase in sustainable biofuel use. Changes may also induce measures other than increased biofuel blending in road fuels as the technology agnostic regulations foster a lowest-cost approach.

F. Increase subsidies for clean technologies

Subsidies can accelerate the adoption of clean technologies and make it cheaper for industries to comply with other policies. Our analysis shows that increasing the federal government's five ITCs for clean technologies, as well as the Net Zero Accelerator Fund and the Clean Fuels Fund, can increase clean technology investment and adoption in a range of sectors, from CCUS to hydrogen to clean electricity. However, while subsidies can reduce costs to industry, they are a more costly way for governments to incentivize emissions reductions. Careful attention should be paid to the size and duration of these subsidies and how they may interact with other policies, including the LETS.

3. Identify new policies to close the gap

While the federal government should prioritize implementing and strengthening climate policies that are already in the works, new policies will likely be needed to close the gap to 2030. We identify three potential policies that the federal government could introduce to drive additional emissions reductions this decade and beyond. As above, these policies are ordered based on our six assessment criteria, with specific emphasis on effectiveness and ease of implementation. While we assessed a potential renewable natural gas (RNG) or hydrogen blending rate, this policy is not recommended due to the significant weaknesses we found.

A. Require all new and replacement building heating systems be non-emitting this decade

Every year, fossil fuel heating equipment is being installed that will last for upwards of 10 years. Getting ahead of this and ensuring that new and replacement building heating systems are non-emitting will help bend the building sector's emissions curve, which has risen steadily since 2005. The government could require all new and replacement building heating systems be non-emitting by 2030, or apply the policy to only new buildings. The government should pair such a requirement with subsidies for low-income households to help cover the upfront costs of equipment and labour for new heating systems.

B. Implement a stronger Medium- and Heavy-Duty Vehicle Standard than has been proposed by the federal government

The federal government has announced plans to develop a medium- and heavy-duty ZEV sales mandate, with the goal of achieving 35 per cent ZEV sales by 2030 and 100 per

cent by 2040 in selected medium- and heavy-duty categories, based on feasibility.

Our analysis suggests that deep emissions reductions in the freight transportation sector, including through a rising market share of zero-emission medium- and heavy-duty vehicles, is a cost-effective way to achieve Canada's 2030 target. The federal government could increase the stringency of the proposed regulations, requiring that 60 per cent of medium-duty and 50 per cent of heavy-duty vehicle sales in 2030 are zero-emission. While these regulations will not have a significant impact in 2030, they are important for ensuring deeper emissions reductions post-2030.

Careful attention should be paid to potential overlap with the Clean Fuel Regulations and the fuel charge. The government could also continue to offer purchase incentives for MHDV ZEVs and charging infrastructure since high upfront costs and access to charging stations remain key barriers to uptake.

C. Introduce efficiency mandate for low-temperature industrial heat

Industrial heating systems are large, long-lived equipment; requiring minimum efficiency or maximum emissions rates will help avoid locking-in fossil fuel-based systems for the coming decades. Given the slow rate of turnover for industrial-scale equipment, this policy may not drive immediate emissions reductions, but it is an important signal to implement now for future investment decisions.

Our analysis underscores that meeting Canada's 2030 emissions reduction target is achievable if the federal government moves quickly to finalize proposed policies, strengthen existing ones, and implement new measures. In particular, we identify and prioritize a set of policy opportunities that could drive cost-effective emissions reductions across sectors to close the gap to Canada's 2030 target. We note that meeting Canada's target will require that governments implement stringent policy well beyond what is currently in place or proposed and emphasize that the federal government should pay careful attention to policy implementation, including where policies may lead to significant economic impacts for households or industry and where policy interactions may reduce effectiveness or increase costs.