Analysis of Canada's proposed Clean Fuel Regulations

Assumptions memo prepared for the Pembina Institute

SUBMITTED TO

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About Us

Navius Research Inc. is an independent and non-partisan consultancy based in Vancouver. We operate proprietary energy-economy modeling software designed to quantify the impacts of climate change mitigation policy on greenhouse gas emissions and the economy. We have been active in this field since 2008 and have become one of Canada's leading experts in modeling the impacts of energy and climate policy. Our analytical framework is used by clients across the country to inform energy and greenhouse gas abatement strategy.

We are proud to have worked with:

- Most provincial and territorial governments, as well as the federal government.
- Utilities, industry associations and energy companies.
- Non-profit and research organizations with an interest in energy, climate change and economics.

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1. Introduction

The Clean Fuel Regulation (CFR), previously known as the Clean Fuel Standard, is a proposed Canadian federal policy designed to reduce the lifecycle carbon intensity of liquid fuels sold in Canada. The CFR is a flexible regulation, which offers multiple compliance pathways, from upstream emissions reductions to biofuel blending and fuel switching. The CFR's policy design has yet to be finalized but the policy is scheduled to come into force this year (2022).

This memo summarizes assumptions related to an analysis of Canada's CFR conducted by Navius Research for Pembina. This analysis was originally conducted in 2021 and subsequently updated in April 2022 to account for CFR and other policy-related developments. While the analysis considered a great range of scenarios designed to explore uncertainty in policy design and other factors, this memo focuses on the scenarios analyzed in Pembina's April 28, 2022 briefing note.

This analysis employs Navius Research's gTech model to simulate Canada's CFR market. This model has been used to conduct extensive analysis of the CFR for government and industry.

This memo:

- Provides a short policy overview (section 2).
- Introduces the gTech model (section 3.1).
- Presents important calibration sources (section 3.2).
- Identifies key assumptions (section 3.3).
- Describes scenario design used for the 2022 analysis (section 3.4).

2. Policy Overview

The federal government is developing a performance-based fuel supply standard requiring liquid fossil fuel suppliers to reduce the lifecycle greenhouse gas intensity of their fuels. The policy will apply to primary fuel suppliers who produce or import at least 400,000 litres of fuel for use in Canada.

The Canada Gazette Part I proposed that the CFR should require regulated entities to reduce the annual emission intensity of their fuels by 2.4 g CO2e/MJ in 2022 up to 12 g CO2e/MJ in 2030. Since the Canada Gazette Part I, multiple policy changes have been proposed, including the exclusion of light and heavy fuel oils as regulated fuels and a carbon intensity reduction requirement that rises to 14 gCO2e/MJ in 2030[1] (Table 1). The CFR's policy design is still uncertain as it has not yet been finalized.

Table 1: Spring 2022 Update proposed annual carbon intensity (CI) reduction requirement (g CO_2e/MJ) for regulated fuels.

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030 and thereafter
CI reduction requirement	0	3.5	5.0	6.5	8.0	9.5	11.0	12.5	14.0

The CFR is known as a "flexible regulation". While it is quite prescriptive in which parties must participate and the extent to which they must reduce the life-cycle carbon intensity of the fuels they supply, it is flexible in that it allows multiple methods of compliance and creates a market for compliance credits. Therefore, a regulated party can comply with the CFR using the lowest cost option, which may include purchasing credits from parties that have voluntarily reduced GHG emissions, rather than directly reducing emissions themselves.

Under the currently proposed policy design (current as of March 2022), liquid CFR compliance credits can be generated through the following pathways:

- **Compliance category 1: Upstream GHG reductions.** This category includes actions that reduce GHG emissions associated with the production of liquid fossil energy,

[1] Environment and Climate Change Canada. 2022. Spring 2022 Update. Available from: ECCC's Clean Fuel Standard public google drive.

such as carbon capture and storage (CCS) for oilsands upgrading and refining, CCS for hydrogen production and refinery process improvements.

- **Compliance category 2: Supply of low carbon intensity fuels.** Credits can be generated by producing low carbon intensity fuels such as ethanol and biodiesel that can be blended into the fossil fuel stream. The number of credits that can be generated through low carbon fuel blending depends on the amount of energy supplied by the fuel and how the carbon intensity of the fuel compares to the liquid class reference carbon intensity (CI) value. The liquid class reference CI value as proposed in the 2022 Spring Update is presented in Table 2.
- **Compliance category 3: End-use fuel switching.** Credits can be generated through end-use fuel switching in transport. This category includes the use of low-carbon fuels such as electricity or hydrogen that displace demand for liquid fuels. Credit generation depends on the amount of energy supplied to vehicles, how the carbon intensity of the low-carbon fuel compares to the liquid class reference CI value, and the difference in energy efficiency between low-carbon fuel vehicles and conventional vehicles. An important aspect of the policy is that credits for residential charging are currently proposed to be phased out between 2031 and 2035.

Table 2: Spring 2022 Update - proposed liquid class carbon reference value (g CO_2e/MJ).

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030 and thereafter
Liquid class reference CI	89.2	89.2	87.9	86.6	85.3	84.0	82.7	81.4	80.1

3. Modeling approach

This section introduces the gTech model, summarizes key calibration sources and modeling assumptions, and describes the scenarios analyzed in Pembina's April 28, 2022 briefing note.

3.1. Introduction to gTech

gTech is ideally suited to simulate development of the CFR because:

- **It is a full economic model.** gTech is a computable general equilibrium (CGE) model that represents transactions between all sectors of the economy. The model can simulate CFR credit demand and supply, the resulting CFR credit price and incremental abatement actions. Credit demand is a function of the amount of regulated fossil fuels used and the stringency of the GHG intensity reduction requirement. The sources of CFR credit supply depend on the available compliance options, cost of abatement actions, consumer and firm technology choices, and overlapping federal and provincial policies. gTech further accounts for how the CFR credit market is influenced by other dynamics in the energy system, such as the price for oil, the price for agricultural feedstocks, the cost of biofuels manufacturing and the cost of transporting fuels between regions.
- **It is technologically explicit.** gTech explicitly simulates how households and firms adopt technologies to meet their demand for energy services (e.g., transportation, heating, etc.). It also includes ten conventional and emerging biofuel pathways. This technological detail enables gTech to forecast how the CFR will impact technology and fuel adoption.
- **It is behaviourally realistic.** Technological choice is strongly influenced by behaviour. In some cases, behaviour has as much or more influence on a decision than financial costs (e.g., whether someone buys an electric vehicle). gTech includes three behavioural dynamics designed to realistically describe how policies will influence technology choice: non-financial preferences, time preference for money and market heterogeneity.
- **It simulates the interactions between policies.** The CFR is one of many policies applied to fossil fuels in Canada. For example, liquid fuel consumption in transport is subject to: (1) excise taxes; (2) provincial and federal renewable fuel requirements; (3) federal vehicle emissions standards; and (4) mandates for zero

emission vehicles. These policies will interact with the CFR by influencing actions that may qualify for compliance under the CFR market.

3.2. Calibration Sources

To characterize Canada's energy-economy, gTech is calibrated to a large variety of historical data sources. Key calibration data sources are listed below:

- Environment and Climate Change Canada's National Inventory Report[2].
- Statistics Canada's Supply-Use Tables[3].
- Natural Resources Canada's Comprehensive Energy Use Database[4].
- Statistics Canada's Annual Industrial Consumption of Energy Survey[5].
- Statistics Canada's Report on Energy Supply and Demand[6].
- Environment and Climate Change Canada's Greenhouse gas emissions from large facilities[7].
- Navius' technology database.

Each of these data sources is generated using different methods and are therefore not necessarily consistent with one another. For example, expenditures on gasoline by households in Statistics Canada's Supply-Use tables may not be consistent with natural gas consumption reported by Natural Resources Canada's Comprehensive Energy Use Database. Further, energy expenditures are a function of consumption and

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[2] Environment and Climate Change Canada. National Inventory Report. Available from: www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/inventory.html

[3] Statistics Canada. Supply and Use Tables. Available from: www150.statcan.gc.ca/n1/en/catalogue/15-602-X

[4] Natural Resources Canada. Comprehensive Energy Use Database. Available from: http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive_tables/list.cfm

[5] Statistics Canada. Annual Industrial Consumption of Energy Survey. Available from: www.statcan.gc.ca

[6] Statistics Canada. Report on Energy Supply and Demand in Canada. Available from: https://www150.statcan.gc.ca/n1/en/catalogue/57-003-X

[7] Environment and Climate Change Canada (2019). Canadian Environmental Sustainability Indicators: Greenhouse gas emissions from large facilities. Available from: www.canada.ca/en/environment-climate-change/services/environmentalindicators/greenhouse-gas-emissions/large-facilities.html.

prices, so if prices vary over the course of the year, it is difficult to perfectly align consumption and expenditures.

gTech's calibration routine places greater emphasis on some data sources relative to others. This approach means that gTech achieves near perfect alignment with data sources receiving the highest priority weight, but alignment starts to diverge from data sources that receive a lower weight.

3.3. Key assumptions

As a flexible regulation that offers multiple pathways for compliance, the outcome of the CFR will depend on the cost of competing compliance options, energy prices and other policies implemented in Canada. Key assumptions that determine the cost and use of compliance actions in this analysis are described below.

3.3.1. Energy prices

In gTech, the price for oil is an external input because oil prices vary as a function of global market dynamics that extend beyond the North American energy market captured by the model. Policies that increase or decrease fossil fuel demand within North America have no impact on benchmark oil prices in the model, which reflect wider global market dynamics. We use a reference forecast reaching $64 USD per barrel in 2030.

While oil prices are set externally, they affect the demand for oil in the model. For example, the model shows that lower global oil prices are likely to result in higher demand for fossil fuels in North America, because driving gasoline vehicles becomes relatively cheaper, for example. They also affect the demand for other energy commodities (e.g., electricity, natural gas, biofuels) as the relative price difference between these options changes.

The price for these other energy commodities is determined by the model based on demand and the cost of production. For example, the price of electricity depends on a variety of factors that are accounted for by the modeling, such as:

- The cost of generating electricity while meeting any policy constraints.
- The cost of maintaining the transmission and distribution network.
- Taxes on or subsidies to the sector.

3.3.2. Interactions with other policies

Federal and provincial policies will interact with the CFR by encouraging GHG abatement actions that also qualify for compliance under the CFR. Accounting for these policies is important because they can affect the supply of CFR credits and hence the credit price.

Carbon pricing

The federal carbon price is scheduled to reach $50 per tonne CO2e in 2022, and a price increase to $170 per tonne CO2e by 2030 was also announced in December 2020[8]. Carbon pricing interacts with the CFR credit market, as it leads to actions, such as switching to electricity in transportation, which can generate credits under the CFR. These credits can be considered "free" or "non-incremental" credits as these actions also would have occurred in the absence of the CFR. Due to this policy overlap, a higher carbon tax will result in lower CFR credit prices and less incremental GHG reductions through an increased supply of "free" credits.

Non-pricing policies

In addition to carbon pricing, a variety of policies have been implemented or announced at a federal or provincial level that are included in this analysis, such as:

- Federal renewable fuel requirements, which will continue as a part of the CFR. These requirements mandate 5% renewable content in gasoline and 2% in diesel (by volume).
- Provincial renewable requirements for liquid fuels. Several provinces have implemented their own requirements that supersede federal policy (e.g., Ontario's renewable fuel requirements).
- Zero-emission vehicle mandates in BC and Québec, which require an increasing share of light-duty vehicles be plug-in electric or hydrogen powered over time.
- BC's CleanBC initiatives include an increase in the stringency of the provincial Renewable and Low Carbon Fuel Requirement, which is currently scheduled to

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[8] Environment and Climate Change Canada. 2020, December 11. A healthy environment and a healthy economy: Canada's strengthened climate plan to create jobs and support people, communities and the planet. www.canada.ca/en/services/environment/weather/climatechange/climate-plan/climate-plan-overview.html

increase to a 20% reduction in the lifecycle carbon intensity of liquid fuels sold relative to 2010[9].

Like the carbon tax, these policies result in abatement actions that are eligible for credit generation under the CFR. This policy overlap reduces the CFR credit price and incremental GHG reductions due to the influx of "free" credits from actions caused by these other federal and provincial policies.

3.3.3. Cost of compliance options

Compliance category 1

Compliance category 1 actions reduce the lifecycle carbon intensity of fossil fuels during their production, refining, and distribution. Actions that may generate credits include, but are not limited to, refinery process improvements, reductions in methane emissions, the use of combined heat and power generation, carbon capture and storage (CCS), and less carbon intensive fuel transport to refuelling stations.

In the RIA it is estimated that upstream greenhouse gas (GHG) reductions through actions such as carbon capture and storage, methane conservation, and refinery process improvements, will generate about 1.5 Mt CO2e in credits in 2025 rising to about 7 Mt CO2e in 2030[10]. gTech can simulate upstream credit generation through CCS endogenously using baseline CCS costs as shown in Table 3.

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[9] Government of British Columbia. 2021. cleanBC. Roadmap to 2030. Available from: https://www2.gov.bc.ca/assets/gov/environment/climate-change/action/cleanbc/cleanbc_roadmap_2030.pdf

[10] Government of Canada. 2020, December 19. Canada Gazette, Part 1, Volume 154, Number 51: Clean Fuel Regulations. http://www.gazette.gc.ca/rp-pr/p1/2020/2020-12-19/html/reg2-eng.html

Table 3: Key abatement opportunities in compliance category 1

Technology/fuel	Approximate abatement cost ($/tonne CO_{2e})*	Sources
CCS for hydrogen production	164 in 2022, declines to a minimum of 109 by 2030.	Global CCS Institute. (2017). Global Costs of Carbon Capture and Storage: 2017 Update; International Energy Agency. (2011). Cost and Performance of Carbon Dioxide Capture from Power Generation; Information provided to Navius by CCS stakeholders in Canada.
CCS for oilsands (natural gas for process heat)	273 in 2022, declines to a minimum of 185 by 2030.	International Energy Agency. (2011). Cost and Performance of Carbon Dioxide Capture from Power Generation.

*Costs are illustrative and will vary in the modeling as they respond to changes in energy prices, technology learning and fuel carbon intensities, all of which are endogenously determined in gTech. Values are in 2020 CAD/t CO_2e captured. Assumptions for values in this table: 15% discount rate, 30-year project life, $3/GJ for natural gas.

Compliance category 2

Compliance category 2 enables credit generation through low-carbon fuel production and import. The production costs of these fuels are generally higher than the cost of fuels they are replacing, which represents the abatement cost. This cost is sensitive to the production cost of renewable fuels as well as the production cost of conventional fuels. The production cost of commercialized biofuels like ethanol, biodiesel and hydrogenated renewable diesel is most sensitive to the price of the agricultural commodity that serves as the feedstock (e.g., corn, canola). In other words, agricultural prices create the largest uncertainty in the production cost.

For emerging biofuels made from ligno-cellulosic material (i.e., woody or grassy material), the production cost is more sensitive to the plant capital cost and utilization (i.e., does the plant produce at its expected output capability?). As they become more commercialized, the costs shown in Table 4 could decline, though this decline could be offset by rising feedstock costs as demand for agricultural and forestry residues tightens.

Note that the baseline abatement costs in Table 4 are shown as an example and may vary in the modeling, largely as a function of changing crude oil, natural gas and renewable fuel feedstock costs.

Table 4: Key abatement opportunities in compliance category 2*

Technology/fuel	Approximate abatement cost ($/tonne CO_2e)**	Sources
Second generation renewable natural gas	248	G4 Insights Inc. (2018). Our Technology; International Energy Agency Energy Technology System Analysis Programme (IEA ETSAP). (2013). Biogas and bio-syngas production; International Renewable Energy Association (IRENA). (2013). Road transport: the cost of renewable solutions; (S&T) Consultants Inc. (2012). Update of Advanced Biofuel Pathways in GHGenius.
Ethanol	156	
Cellulosic ethanol	172	
Biodiesel	116	
Hydrogenated renewable diesel	149	
Second generation renewable gasoline/diesel	411	

*Assumptions made to calculate the approximate abatement cost of these fuels are provided here. Second generation renewable natural gas: feedstock at $70/dry tonne, approximate wholesale cost of $16/GJ. Ethanol: corn at $169/tonne, approximate wholesale cost of $23/GJ. Cellulosic ethanol: feedstock at $70/dry tonne, approximate wholesale cost of $31/GJ. Biodiesel: Canola seed at $414/tonne, approximate wholesale cost of $25/GJ. Hydrogenated renewable diesel: canola seed at $414/tonne, approximate wholesale cost of $26/GJ. Second generation renewable gasoline/diesel: feedstock at $70/dry tonne, approximate wholesale cost of $44/GJ.

**Costs are illustrative and will vary in the modeling as they respond to changes in energy prices, technology learning and fuel carbon intensities, all of which are endogenously determined in gTech. Values are in 2020 CAD/t CO_2e captured. Assumptions for values in this table: 15% discount rate, 30-year project life, $3/GJ for natural gas.

Compliance category 3

Under compliance category 3, CFR credits can be created through fuel switching in transport, for example by switching to plug-in electric and hydrogen fuel cell vehicles (see Table 5). Our modelling includes these alternative-fuel drivetrains as an option for light-duty vehicles, medium and heavy-duty vehicles, and buses. The adoption of these technologies is a function of their upfront costs (for vehicles and charging infrastructure where appropriate), energy costs, and a dynamic representation of the barriers to their adoption (i.e., the implied cost of limited charging/fueling infrastructure, range concerns, unfamiliarity with the technologies, lack of supply).

Table 5: Key abatement opportunities in compliance category 3

Technology/fuel	Cost	Sources
Plug-in electric vehicles[11]	Battery pack costs decline from $492/kWh in 2015 to a minimum of $82/kWh.	Bloomberg New Energy Finance. (2020). Electric vehicle outlook; ICCT. (2019). Update on electric vehicle costs in the United States through 2030; Nykvist, B., F. Sprei, et al. (2019). "Assessing the progress toward lower priced long range battery electric vehicles." Energy Policy 124: 144-155.
Hydrogen fuel cell electric vehicles	Fuel cell stack system costs decline from $300/kW in 2015 to a minimum of $73/kW.	SA Consultants. (2016). Final report: Hydrogen storage system cost analysis; SA Consultants. (2017). Mass production cost estimation of direct H2 PEM fuel cell systems for transportation applications;
	Fuel tanks decline from $30/kWh in 2015 to a minimum of $11/kWh.	IEA. (2020). Breakdown of cost-reduction potential for electrochemical devices by component category.

Flexibility Mechanisms

The Canada Gazette Part I proposes some market flexibility and stability mechanisms for compliance. These mechanisms are included with the following assumptions:

- **Early credit creation, credit banking and deficit carry forward.** This analysis assumes perfect market clearance, which means that at the end of a compliance period there is a perfect balance between demand and supply of credits and no surplus credits or deficits remain. While we do not simulate credit banking, we have included a fixed quantity of banked credits, assumed to come from early compliance. These are banked in the first year of the forecast and then used in the following years of the forecast. This assumption is based on the banked credits estimate used in ECCC's Regulatory Impact Analysis (RIA).
- **Credit clearance mechanism (CCM).** The CCM enables those with credit deficits and surplus credits to trade at the end of a compliance period to reduce carried forward deficits. As described above, this analysis assumes perfect market clearance while aligning assumptions on credit banking with those used in ECCC's RIA.

[11] Note that credits for home charging are phased out by 2035.

- **Compliance Fund.** The compliance fund provides a trading price ceiling at $350/t CO2e, indexed for inflation, and is simulated as such. This analysis assumes that credits will only be purchased from this fund if there are no lower cost alternatives, and it is therefore possible that results show no use of this fund.
- **Inter-stream emission reductions.** It is uncertain if gaseous credit generation through compliance pathway 2 and inter-stream credit trading will remain an option. Under the Canada Gazette Part I policy design, producers or importers of renewable gaseous fuels, such as biogas and hydrogen, could generate credits eligible up to 10% of a regulated entity's compliance obligation. In this analysis, we assume this these compliance pathway will remain as the Spring 2022 update proposed an updated carbon reference value for gaseous fuels.

3.4. Scenarios

In this analysis, we investigate the greenhouse gas impact of the CFR relative to a reference case that includes legislated policies as well as the federal carbon pricing increase to $170 per tonne CO2e by 2030 and the announced federal light-duty zero emissions vehicle (ZEV) mandate[12]. The current CFR scenario is based on the draft regulations published in the Canada Gazette Part I[13], as well as policy updates that have been made since (up to March 2022). Table 6 shows key assumptions for the CFR after the March 2022 Spring Update.

Table 6: 2022 Spring Update CFR simulation assumptions.

Item	Assumptions
Carbon Reference Values and CI reduction requirement	This analysis uses the liquid and gaseous carbon reference values as presented in the 2022 Spring Update. It further includes a stringency increase in life cycle carbon intensity reduction requirement set at 14 grams CO2e/MJ by 2030, revised from the previous value of 12.
Regulated fuels	Light and heavy fuel oils are excluded from the list of regulated fuels.
Upstream Credit Generation (Compliance Category 1)	Upstream credit generation is aligned with ECCC's assumption that 2.3 Mt CO2e in credits will be generated through actions such as methane conservation and refinery process improvements in 2025 and rise to 2.9 Mt Co2e in 2030. Credit creation through carbon capture and storage is endogenously simulated by gTech as a function of compliance costs and provincial and federal policies. All CCS projects

[12] As there are currently little details on policy design available, we assume that a policy similar to Québec's ZEV mandate will be implemented.

[13] Government of Canada. 2020, December 19. Canada Gazette, Part 1, Volume 154, Number 51: Clean Fuel Regulations. http://www.gazette.gc.ca/rp-pr/p1/2020/2020-12-19/html/reg2-eng.html.

Item	Assumptions
	linked to liquid fossil fuel production are assumed to be considered “additional” and qualify for CFR credit generation.
Fuel Blending (Compliance Category 2)	Fuel blending is endogenously simulated by the model as a function of production and transportation costs as well as provincial and federal policies.
Credit generation through fuel switching in transportation (Compliance Category 3)	We use variable electricity carbon intensities based on prior gTech results. This approach accounts for the impact of electricity decarbonization driven by policies such as carbon pricing and regulations, which will impact the CFR credit market and allow for more credit generation through electrification. We assume that 30% of light-duty vehicle home charging will be adequately metered to generate credits under the CFR. This value is uncertain and differs from the 10% of residential charging assumed to be adequately metered to generate credits in the CFR Canada Gazette Part I Regulatory Impact Analysis.
Interstream credit trading	We assume that instream credit trading remains a CFR credit creation pathway that can be used towards 10% of liquid compliance.
Credit banking	The Canada Gazette Part I Regulatory Impact Analysis (RIA) assumes that about 2 Mt CO2e of banked credits will be used to comply with the CFR in 2025 and that banked credits will drop to zero in 2028 and remain at zero thereafter. We have aligned the assumption on the number of banked credits used in each modeling period with the RIA estimate.

In the 2022 Spring update, a potential increase in the life cycle carbon intensity reduction requirement from 12 grams CO2e/MJ to 14 gCO2e/MJ by 2030 was announced. This is equivalent to a 16% instead of a 13% reduction requirement relative to the 2016 average fuel carbon intensity. We further simulate two illustrative strengthened CFR scenarios, which increase the carbon intensity (CI) reduction requirement to 20% and 30% relative to 2016 in 2030. These stringency increases are equivalent to an 18 gCO2e/MJ and 27 gCO2e/MJ reduction requirement by 2030, respectively.

Note that this analysis does not include a ZEV regulation for heavy-duty ZEVs, as announced but not defined in the Emissions Reduction Plan (ERP)[14]. Similar to a federal light-duty ZEV mandate, this policy would overlap with the CFR and reduce the incremental GHG reductions attributable to the CFR. Policy overlap can also occur with the GHG cap on oil and gas extraction, announced in the ERP, unless compliance category 1 additionality criteria are set to avoid credit stacking under the oil and gas cap and the CFR. Furthermore, policy stringency increases in provincial transportation

[14] Environment and Climate Change Canada (2022). 2030 Emissions Reduction Plan. Canada’s Next Steps for Clean Air and a Strong Economy, p. 61. Available from: https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/erp/Canada-2030-Emissions-Reduction-Plan-eng.pdf

policies, for example an announced accelerated timeline for British Columbia's ZEV mandate[15], will also lead to increasing policy overlap with the CFR.

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[15] British Columbia (2021). CleanBC. RoadMap to 2030. Available from: https://www2.gov.bc.ca/assets/gov/environment/climate-change/action/cleanbc/cleanbc_roadmap_2030.pdf

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