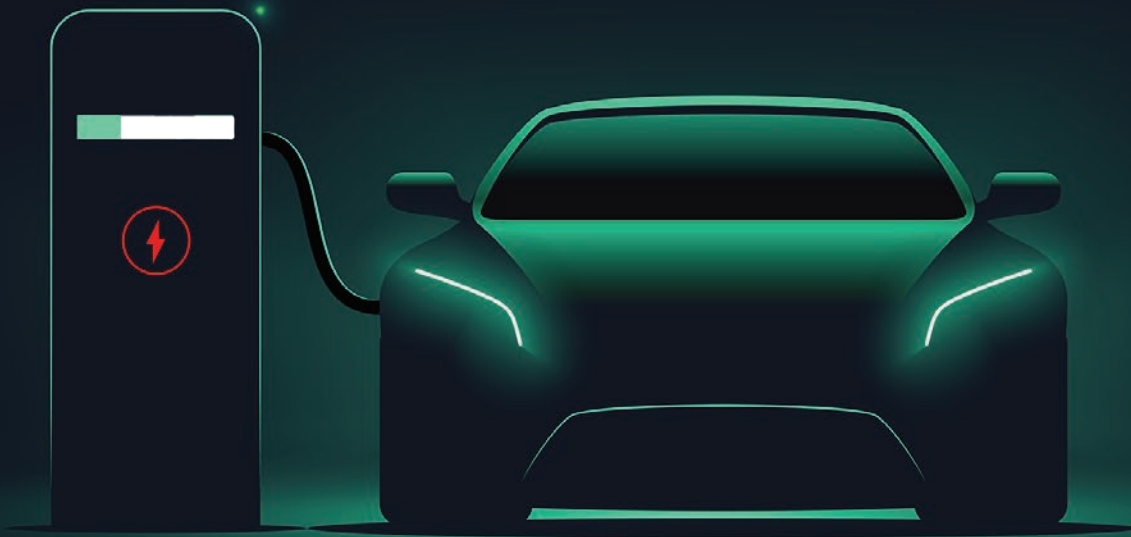


FAILURE TO CHARGE

A Critical Look at Canada's EV Policy



A Review of Electric Vehicle Consumer Subsidies in Canada

Jock Finlayson and Karen Graham

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EXECUTIVE SUMMARY

Globally, the market for electric vehicles (EVs) is expanding rapidly. Last year, worldwide EV sales exceeded 10 million for the first time, representing 14 percent of all new vehicles purchased, up from less than 5 percent in the late 2010s. Rising EV market penetration reflects greater efficiency in EV and related parts manufacturing, improvements in the battery and storage technologies that underpin EVs, and the impact of government policies to encourage the development of the EV industry and boost consumer demand.

This essay looks at EV purchase subsidies in Canada, which have been introduced to accelerate market uptake of these vehicles as part of governments' efforts to reduce greenhouse gas (GHG) emissions that contribute to climate change. Transportation accounts for almost one-quarter of Canada's total GHG emissions, so it is not surprising that Canadian policymakers are focusing on emissions from this sector.

The subsidies examined in this paper consist of a national \$5,000 EV incentive adopted by the federal government and separate incentives implemented by several of the provinces. We evaluate these incentives through three lenses: efficiency, the impact on carbon emissions from the passenger transportation segment, and equity considerations.

It is important to note that apart from subsidizing the purchase of EVs, governments in Canada have enacted other policies intended

to reduce transportation-based GHG emissions. These policies include a minimum national carbon levy, the establishment of electric vehicle production mandates requiring that EVs account for a rising share of all new vehicle sales (reaching 100 percent by 2035), and direct government financing to accelerate the roll-out of EV charging stations and supporting infrastructures. There are also large and rapidly growing government subsidies in Canada for the production of EV batteries and the vehicles themselves, which are not reviewed in this essay.

Our examination of existing EV consumer incentives finds that they are an inefficient way to reduce emissions judged by the cost of abatement, particularly compared to the national carbon levy legislated by the federal government that applies across Canada and is set to climb from \$65/tonne in 2023 to \$170/tonne by 2030. The inefficiency is partly because some portion of consumer EV purchases would be made absent any subsidy. Of greater concern, the EV purchase incentives in place in Canada today have a cost per ton of GHG abated that substantially exceeds both the national backstop carbon price and most estimates of the broader “social cost of carbon.”

The impact of EV incentives on emissions depends on the types of electric vehicles sold in the domestic market, the “life-cycle” emissions of EVs, and—most importantly—the source of the electricity produced in the various provinces. Increasing EV market penetration is expected to result in lower Canadian emissions in the vehicle segment, but not in a uniform way given the varying fuel mix in the provinces’ electricity sectors. Specifically, in provinces like Alberta and Saskatchewan, where electricity generation heavily relies on fossil fuels, a higher number of electric vehicles on the roads could potentially increase the demand for fossil-fuel-powered electricity, thereby undermining the expected GHG reduction benefits.

Finally, equity considerations are also relevant to assessing EV subsidies. The US academic literature indicates that up to 90 percent of EV purchase incentives adopted by the federal government have flowed to the richest one-fifth of households. To date, most EV buyers in the US and Canada have had incomes well above the respective national

“Consumer subsidies for purchasing EVs are among the most expensive tools governments can use to lower GHG emissions.”



average. As more EVs at lower price points enter the market, the picture is likely to change. Unlike the federal government’s EV incentive program, British Columbia’s provincial subsidy includes an income threshold test to help address equity concerns.

We conclude that consumer EV incentives make little sense in Canada. In

contrast to the United States, Canada maintains a robust carbon pricing regime which will encourage the shift to lower-carbon energy sources, production methods, and consumption choices. Layering EV purchase subsidies on top of the existing national carbon tax increases the overall cost of carbon abatement and adds to the fiscal burden shouldered by Canadian taxpayers.

INTRODUCTION

Globally, the market for electric vehicles (EVs) is expanding rapidly. Last year, worldwide EV sales exceeded 10 million for the first time, representing 14 percent of new vehicles purchased—up from less than 5 percent in 2020 (IEA, 2023). The three main EV markets are China (the largest, accounting for three-fifth of EV sales in 2022),¹ Europe, and North America. Projections indicate that EV purchases will continue to climb both in absolute numbers and as a share of all new passenger vehicle sales.



Rising EV market penetration reflects a mix of trends. First, the production of EVs has become more efficient as the overall market has expanded and vehicle manufacturers and parts suppliers have increased production volumes and improved their operations. Second, the key technologies underlying the EV industry—including those involving batteries and energy storage—have continued to advance, helping to reduce costs and enhance reliability (IEA, 2023). Finally, government policies have played a pivotal role in encouraging the development of the EV industry and in boosting consumer demand. These policies include higher taxes on the fossil fuels used in conventional internal combustion engine (ICE) vehicles, legislated targets to reduce national and sub-national jurisdictions' greenhouse gas (GHG) emissions (including carbon dioxide emissions² from transportation),

1 Roughly half of all EVs on the roads worldwide are in China (IEA, 2023).

2 The use of liquid fossil fuels (gasoline and diesel) to power ICE vehicles produces carbon emissions, which are the largest source of greenhouse gas (GHG) emissions—carbon accounts for roughly three-quarters of global GHG emissions. The other sources of GHGs include methane and nitrous oxides. This paper uses the terms carbon emissions and GHG emissions interchangeably, even though carbon dioxide is responsible for almost all transportation-related GHG emissions. It should be noted that in setting national climate policy goals and targets, governments generally focus on reducing total GHG emissions, not carbon emissions.

and a mix of regulations and product standards affecting both vehicle manufacturing and the oil and fuel refining industries. More recently, some governments (including Canada's) have provided large-scale subsidies and tax incentives to convince EV and battery manufacturing firms to invest in building new production capacity.

In Canada, the drive to increase passenger electric vehicle (EV) uptake is underpinned by a growing array of federal, provincial, and territorial government programs. The most visible to consumers are direct financial incentives, or subsidies, offered by the federal and some provincial governments to purchase an EV. For policymakers, the main objective of electrifying the vehicle fleet is to reduce transportation-related greenhouse gas emissions. This is unsurprising considering that transportation is responsible for almost one quarter of Canada's total GHG emissions, with passenger (light duty) vehicles accounting for approximately half of that amount.

In recent years, the federal government has implemented several policies to reduce emissions from transportation, including:

- mandating a minimum national carbon tax on fossil fuels that is set to rise steadily over the rest of the decade;
- the adoption of renewable fuel standards to reduce the carbon content of liquid fuels;
- the establishment of electric vehicle production mandates (i.e., a minimum number of passenger EVs: 20 percent of all new vehicle sales in 2026, 60 percent in 2030, 100 percent in 2035);
- government financing to accelerate the roll-out of EV charging stations and supporting infrastructure;
- and, in Budget 2023, billions of dollars in fresh incentives to expand both carbon-free electricity generation and the Canadian power grid.

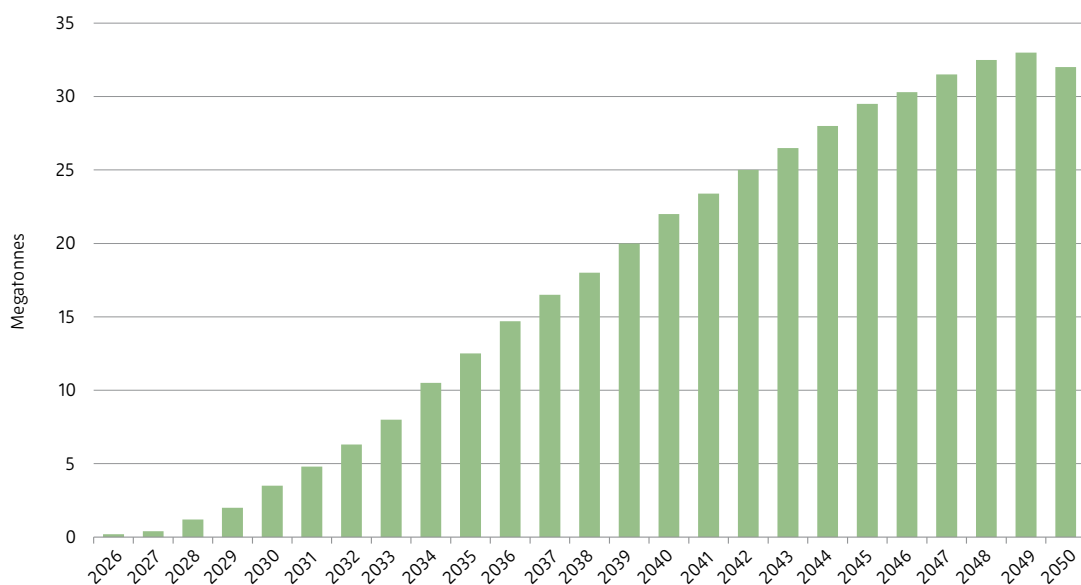
This paper looks specifically at incentives for consumer EV purchases of light-duty vehicles and asks whether these subsidies are efficient, whether they are likely to have a material impact on Canada's GHG emissions, and whether they incorporate sufficient equity considerations.

We define EVs to include all categories of vehicles that use electric power in whole or in part, including battery powered EVs and plug-in hybrid EVs. While governments also subsidize home and public EV charging, which is important to the operation of EVs, in this paper we touch on this aspect only in the context of the provincial energy mix supplying electrical power (the lifecycle analysis of emissions abatement).

Background—Transportation emissions projections for Canada and British Columbia

Canada's 2022 Emissions Reduction Plan (ERP) and British Columbia's CleanBC Plan each set targets for reducing GHGs across various sectors of economic activity. The plans are ambitious to say the least, mandating dramatic emissions reductions by 2030 (only seven years away), even though in the past two decades Canada's annual emissions have posted only very small declines. The climate policy and GHG reduction roadmaps released by governments across Canada tend to be vague, embodying sweeping ambition yet lacking convincing details on how to meet the specified targets within the relatively short time frames. The CD Howe Institute recently prepared an analysis placing some much-needed quantitative markers around the efforts that will be required to meet the federal government's chosen GHG reduction targets and estimating the magnitude of the anticipated gaps (Livingston, 2022 and 2023).

For Canada, delivering on the federal government's ERP targets means reducing total GHG emissions to 442 megatonnes (Mt) by the end of the decade. Projected 2030 GHG emissions are currently pegged at 582 Mt, yielding an estimated gap of 140 Mt. Specific to transportation, there is a gap of 34 Mt between the 2030 federal target of 143 Mt and the forecast level of emissions of 177 Mt. The CD Howe Institute's modelling indicates that passenger vehicle (cars plus light trucks) emissions would need to decline by 18 Mt to meet the sector's share of the federal ERP 2030 target. The same modelling suggests that the passenger vehicle category, together with freight trucks, will account for the largest shortfall between projected 2030 emissions and the federal government's ERP 2030 target.

Figure 1: Reduction of Annual Emissions of Greenhouse Gases projected for EV mandate (Mt)

Source: Environment and Climate Change Canada and Health Canada (2022).

For British Columbia, meeting the NDP government's 2030 CleanBC target would require a 39 percent drop in total GHG emissions from 64 Mt to 39 Mt by 2030—an almost impossible goal absent shutting down large parts of the province's economy or quickly adopting low- and no-carbon technologies across multiple sectors. At present, the government claims BC's emissions are on track to decline to 55 Mt by 2030, leaving a gap of 16 Mt or 29 percent of 2020 emissions by 2030. Approximately 12 Mt of this reduction is expected to come from finding ways to sharply lower emissions from transportation. In fact, the transportation sector is modelled to have the largest shortfall between the 2030 target and projected 2030 emissions (8 Mt) and will therefore need to achieve the steepest emissions reductions to meet the target, specifically in passenger vehicles and freight trucks.

Is the effort required to achieve a relatively quick switch in Canada's transportation mix to all- or mostly EVs to aid in meeting government-mandated GHG targets technically feasible? And can it be achieved at an acceptable economic and societal cost?

Environment and Climate Change Canada (ECCC) and Health Canada recently published estimates of annual incremental GHG reductions in the Regulatory Impact Analysis Statement (RIAS) filed on December 31, 2022, in connection with *Regulations Amending the Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations* (to align them with the government's 2022 Emissions Reduction Plan). A cumulative reduction of 430 Mt is projected from 2026 to 2050 (figure 1), valued at \$19.2 billion in avoided global damages, at a Social Cost of Carbon (SCC) ranging from \$59 in 2025 to \$89 per tonne in 2050 based on a social discount rate of 3 percent. (We will discuss the SCC in greater detail in the next section.) A reduction of about 15 Mt for passenger vehicles is expected by 2035, the year by which 100 percent of new vehicles sold in Canada are supposed to be EVs. However, despite this 100 percent EV sales mandate, conventional vehicles of various vintages and types will continue to be on Canadian roads for many more years, particularly since the average age of the vehicle fleet has been increasing. The incremental EV and home charger costs of the regulation are estimated at \$24.5 billion, and the net energy savings are estimated at \$33.9 billion (net electricity costs of \$55.8 billion minus net fossil fuel savings of \$89.7 billion).

To turbocharge this shift to EVs, Canada and some provinces and territories are giving people an incentive to purchase EVs (table 1). The federal government alone has committed \$2.3 billion (\$1.7 billion in the ERP on top of two tranches of \$330 million to launch and expand the Incentive for Zero Emission Vehicles (iZEV Program).

Table 1: EV Incentives by Canadian Jurisdiction, per Vehicle

Jurisdiction*	Canada	BC	AB	SK	MB	ON	QC	NS	NB	PE	NL	YT	NT	NU
Incentive (\$)	5,000	4,000	N/A	N/A	N/A	N/A	7,000	3,000	5,000	5,000	2,500	5,000	N/A	N/A

* Where a range of incentives is available, the maximum value is shown.
Source: Canada Drives (undated a).

EFFICIENCY

Governments in Canada subsidize purchases of new passenger EVs. Those subsidies range from a floor of \$5,000 per eligible vehicle that applies across the country to a maximum of \$12,000 per eligible vehicle in Quebec (a combined federal and provincial incentive). Behavioural research has demonstrated that such incentives do influence consumer behaviour, albeit to varying degrees.

Several Canadian environmental organizations cite the effect of the Ontario government's cancellation of its \$14,000 per eligible vehicle subsidy in 2018 as evidence that such incentives have a strong impact on consumer decisions. After Ontario made this change, purchases of EVs reportedly fell by just over half. However, StatsCan data tell a somewhat different story, indicating that vehicle sales in Ontario *increased* year over year by 188 percent for battery electric vehicles and by 58 percent for partial or fully electric vehicles (Statistics Canada, 2023). Overall EV category sales did, however, decline in 2018-2019 (15 percent) and 2019-2020 (26 percent), following cancellation of the province's EV purchase subsidy. Battery EV sales in Ontario increased by 49 percent from 2020 to 2021 and by 76 percent from 2021 to 2022. These findings suggest that many households with both the motivation and means to purchase an EV were not deterred by Ontario's decision to scrap the province's EV purchase subsidy (see Section 4 for equity considerations). On the other hand, research on jurisdictions with strong EV uptake (e.g., Norway, California, and Quebec) and international regression studies do point to a significant positive correlation between consumer financial incentives and overall EV purchases as well as EV market share (see Lemphers, Bernstein, Hoffmann, and Wolfe, 2021).

Undoubtedly, defraying a share of the higher upfront cost of an EV makes it more attractive for buyers to choose a new EV over a conventional vehicle. However, research on the efficiency of EV subsidies, generally based on marginal abatement cost analyses, has found that consumer subsidies for purchasing EVs are among the most expensive

tools governments can use to lower GHG emissions, measured as dollars spent to achieve a given amount of GHG reduction.

Most such analyses start from the basis that a country's SCC is a reasonable benchmark price at which society is willing to invest to reduce GHG emissions. Marginal abatement cost analyses assign a cost to efforts to abate one tonne of carbon from the atmosphere.³ Changes in marginal costs over time allow analysts to plot data points, resulting in marginal abatement cost curves that can be assessed against the SCC to evaluate whether a given action or policy measure is an appropriate investment. The official Canadian estimate of the SCC was updated in December 2022 from \$50/tonne to \$261/tonne for 2023. For 2050, the revised estimate for the SCC will jump from \$89/tonne to \$394/tonne (note that the RIAS amending the Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations was published before the federal government produced the new, higher SCC).

Other analyses argue that publicly funded investments in excess of the SCC are valid—up to a point—to enable or speed widespread adoption of new technologies or to advance large-scale climate reduction projects such as carbon capture, utilization and storage. For example, the United Nations Environment Program's *Emissions Gap Report* (2017) recommended that societies could sustain reductions costing no more than US\$100/tonne or CA\$130/tonne abated).⁴ For present purposes, a benchmark of CA\$130/tonne is useful as a test of the affordability of public costs of emissions reduction policies, including those for the adoption of EVs.

According to a 2022 Macdonald-Laurier Institute analysis by Jerome Gessaroli, the direct financial subsidy of EV purchases by governments in Canada exceeds this \$130/tonne threshold, and even exceeds the

3 Carbon dioxide accounts for a little over 75 percent of global GHG emissions. Methane, mainly from agriculture, accounts for 16 percent.

4 We note the UNEP *Emissions Gap Report, 2022* departs from this approach, citing models as being unrealistic because real-world economies do not function as efficiently as modelled, and noting that “mitigation cost estimates of least-cost pathways disregard the economic benefits that accrue through avoided damages and societal co-benefits of a low-carbon transition, such as improved public health because of improved air quality” (p. 31).

federal government's updated estimate of the SCC of \$261/tonne. In provinces and territories without their own EV purchase incentives, the federal subsidy of \$5,000 per vehicle translates to a direct cost of \$177 per tonne of GHGs abated as of 2022. In provinces with their own EV purchase incentives, the rate ranges from \$266 in Newfoundland & Labrador to \$428 in Quebec (adjusted for the reduced Quebec subsidy of \$7,000 per EV, based on row 2 of table 2).

The limitation of these figures, according to the Macdonald-Laurier Institute paper, is that 100 percent of EV purchases are assumed to be due *solely to the available subsidies*. However, existing research estimates that even without the subsidies, the number of EV sales would only fall by half, suggesting that the cost per tonne abated arguably should be multiplied by two (so as to transfer all of the value to subsidy-dependent buyers). This results in an overall marginal cost of GHG reductions per tonne of \$355 for the federal subsidy, \$512 for the federal plus Newfoundland & Labrador subsidy, and \$857 for the federal plus Quebec subsidy (based on row 3 of table 2).

While clearly popular with prospective EV purchasers (and some voters), and a driver of a sizable fraction of recent EV sales, a marginal abatement cost in the range of roughly \$355 to \$857 per tonne—depending on the province—of GHG emissions averted counts as expensive climate policy using any reasonable analytical framework. Related work published by researchers at Dalhousie University in 2019 found, unsurprisingly, that the higher the EV subsidy, the higher the marginal cost per tonne of GHGs abated.

Table 2: Cost per Tonne of GHGs Abated through Canadian EV Subsidies

	AB/SK/ MB/ON	QC	PE/ NB	BC/NS	NL
1. Total federal/provincial subsidy	\$5,000	\$13,000	\$10,000	\$8,000	\$7,500
2. Cost per tonne GHG abated	\$177*	\$428	\$355	\$284	\$266
3. Marginal cost of GHG reductions	\$355	\$857	\$752 (PEI) \$710 (NB)	\$618 (BC) \$602 (NS)	\$512

* The \$177 per tonne GHG abated would be the total program's cost in Alberta, Saskatchewan, Manitoba, and Ontario, where only the federal subsidy is available.

Source: Gessaroli (2022).

There are more efficient public policies available to reduce carbon dioxide and other GHG emissions. In advance of the federal government's introduction of the nationwide carbon tax backstop, Canada's EcoFiscal Commission reported on the general consensus among environmental and mainstream economists that a visible and predictably rising carbon tax acts as a transparent behaviour change signal throughout the economy, enabling consumers and businesses to make adjustments to their planned purchases and activities—such as purchasing an EV—that lower emissions and reduce their cost exposure to the tax. Since Canadians already pay a carbon tax, subsidies layered on top of the tax to provide an incentive to purchase EVs simply increase the total cost—by a significant margin—of emissions reductions (Dahlby, Drummond, Frank, et al., 2019).

At a general level, governments ought to be prudent with taxpayer dollars, particularly given the rising cost of living in Canada in the early-to-mid 2020s when the global economy continues to grapple with supply, procurement, and production disruptions across markets for many commodities, goods, and services. Beyond that, policymakers also should be sensitive to the broader economic costs stemming from their climate policy choices, which are not limited to the direct costs to the taxpayers who ultimately fund subsidy and incentive programs.

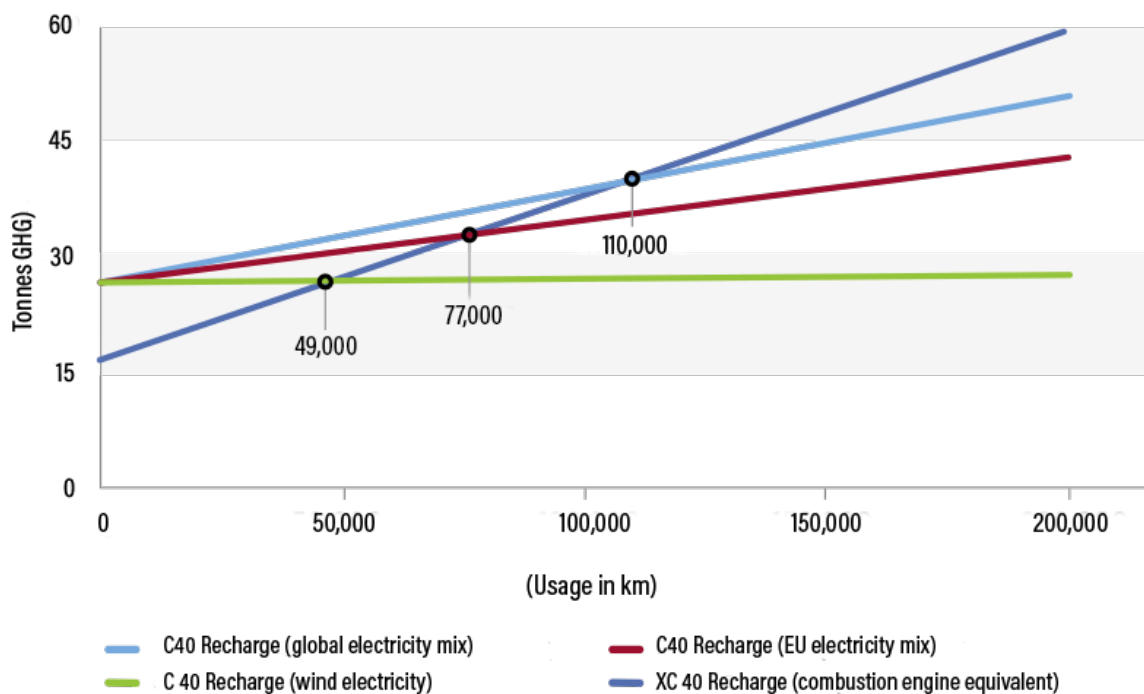
EMISSIONS

The writings from most Canadian environmental policy organizations take it as self-evident that there is an unbroken causal link between increasing the number of EVs on the roads (regardless of costs borne by taxpayers) and declining carbon emissions. Logically, a large-scale shift from conventional vehicles to EVs will eventually play a non-trivial role in driving down Canadian emissions, thereby helping to meet the transportation sector GHG reduction targets set by the current federal government.

Proponents of hefty EV subsidies also tend to regard GHG reductions in passenger transportation as relatively simple math: substitute an EV for a conventional car, and net emissions go down. The impact of incremental new EVs on the roads on incremental GHG emission reductions is not quite so easy to measure, however. One cannot simply substitute vehicles one-for-one from internal combustion engines to EVs. The type of EV (including its range and therefore battery weight and also the GHG-intensity of its manufacture), and the source of the electric charge, are two factors requiring nuance when analyzing the lifecycle emissions impacts of shifting to EVs. The picture is in fact quite complex (Doshi and Metcalf, 2023; Oğuz, 2023).

As cited in the Macdonald-Laurier Institute's analysis, Volvo, a prominent EV manufacturer, provides candid data on its vehicles' lifecycle emissions. Specifically, the C40 Recharge—whose estimated range of 364 kilometres requires a battery that entails 70 percent more GHGs emitted at the production phase than a similar ICE vehicle—will meet an operational emission “break-even” point with a similar conventional vehicle at 49,000 to 110,000 kilometers (see figure 2), depending on GHG-intensity of the electricity source and the longevity of the original battery. Author Jerome Gessaroli notes that purchase subsidies for longer-range EVs, and therefore more GHG-intensive batteries, will

Figure 2: Break-Even Distance Travelled for Emissions Parity for the Volvo C40 Recharge



Source: Gessaroli (2022).

become even more expensive as the degree of GHG abatement is less when considering the vehicle’s full lifecycle.

Turning to the GHG impact of EVs by provincial electricity source, an analysis by Dalhousie University researchers in 2019 took three mid-size vehicle types (the Honda Civic conventional engine for its best-in-class tailpipe emissions, the Toyota Prius hybrid electric for its best-in-class tailpipe emissions, and the Hyundai Ioniq for its best-in-class EV range) and charted their GHG impact by province and by electricity generation mix. Researchers Zachary Thorne and Larry Hughes then estimated the GHG impact if the conventional vehicle (Honda Civic) and the hybrid (Toyota Prius) were substituted with the EV (Hyundai Ioniq).

According to the model they used in their study, in Alberta, Saskatchewan, and Nova Scotia, the electricity mix is sufficiently GHG-intensive that the lifecycle emissions of the Ioniq EV exceed those of the Prius

hybrid.⁵ Therefore, policymakers must be cautious in designing any EV incentive in these provinces (including the federal subsidy that applies regardless of provincial policy). For the rest of the country, it remains an expensive and relatively ineffective climate measure to subsidize emissions reductions at the consumer EV level. If the emissions abated by switching from a 2019 Honda Civic to a 2019 Hyundai Ioniq are approximately two tonnes per annum in BC, Quebec, and New Brunswick, as estimated by the Dalhousie study, the price per tonne of GHGs averted can in some cases equate to a government subsidy sufficient to pay for half a year of EV driving (Thorne and Hughes, 2019).

These findings have several implications for the adoption of EVs across Canada. First, the underlying electricity source and mix obviously matters for a lifecycle analysis of the net emissions benefits of an across-the-board EV switch. Some research into EV adoption in the United States has found that, in certain circumstances, putting more EVs on the roads may increase the demand for fossil-fuel-powered electricity, thereby undercutting any GHG reduction benefits (Gillingham, Ovaere, and Weber, 2021).⁶ Second, consumer subsidies for EV purchases don't presently make sense in provinces where highly efficient liquid fuel vehicles (i.e., hybrids in the Dalhousie study referenced above) have a lower carbon footprint than EVs. Third, while the federal government in its 2023 Budget commits some \$28 billion in tax credits and grants to boost non-carbon power generation and expand transmission system inter-connections, the realistic pace of the energy transition means policymakers should take time to clarify and streamline the ever-growing array of climate policy measures, including the carbon tax and renewable fuel standards that aim to alter consumer and producer behaviour.

EV subsidies are expensive for Canadian taxpayers and, depending on the province, are only moderately effective at reducing GHG emissions. At a minimum of \$177 per tonne (or \$355/tonne assuming only 50

5 It should be noted that Alberta has been reducing the role of coal-fired power in the province's electricity system in the past several years, shifting to natural gas and renewables.

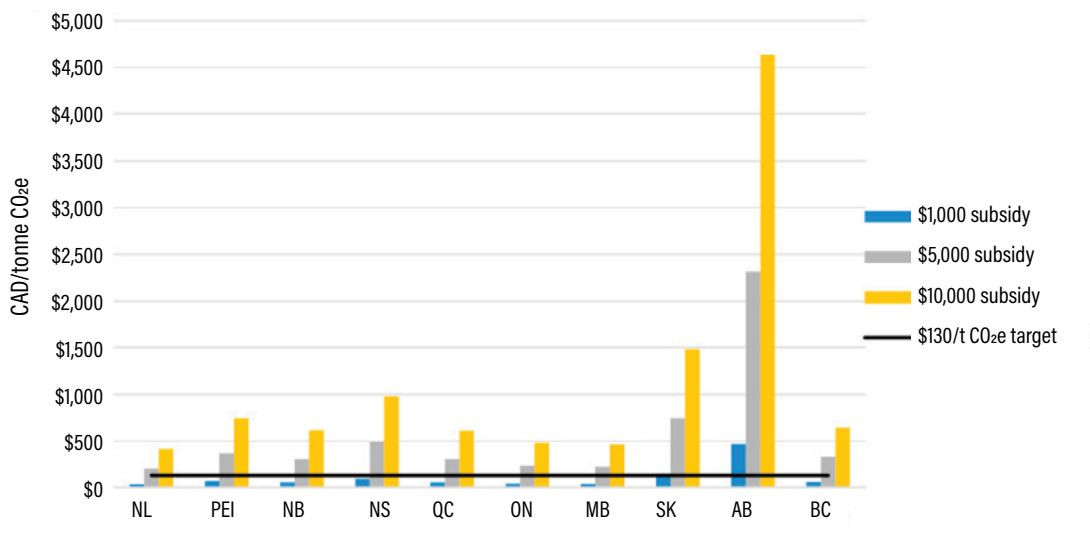
6 This is less likely to be an issue in Canada given that around four-fifths of the electricity produced in the country comes from carbon-free sources.

percent of purchasers switch to EVs principally because of the subsidy), the EV subsidies far exceed the benchmarks against which it is appropriate to analyze the cost of them. By comparison, Canada's present carbon tax is pegged at \$65/tonne, rising to \$170/tonne in 2030 (five years after the federal iZEV program is set to expire).

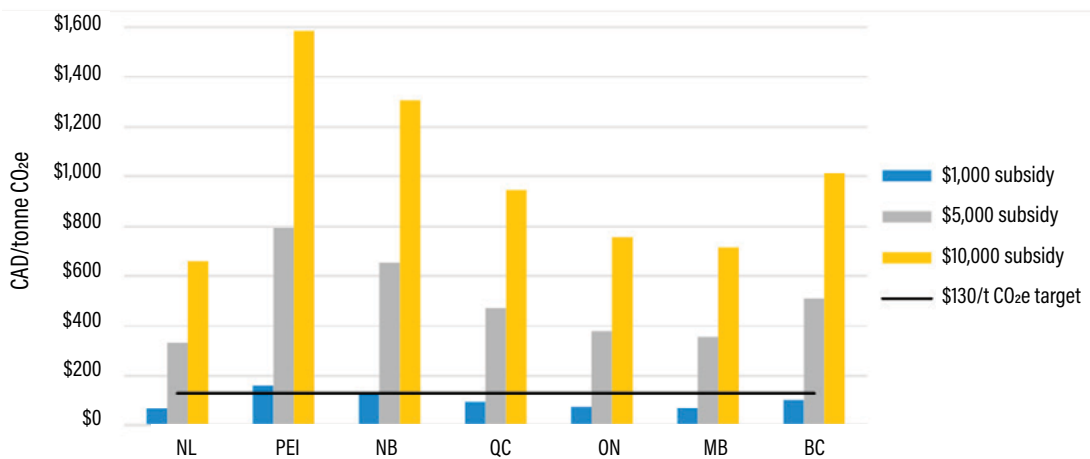
While the subsidy is a one-time benefit to EV purchasers, it is appropriate to consider it against the lifetime of the vehicle in order to estimate the cost of avoided emissions. The Dalhousie University study referenced above does just that, setting three subsidy levels and comparing emissions reductions among the same three mid-sized vehicles (Honda Civic compared to Hyundai Ioniq, and Toyota Prius compared to Hyundai Ioniq), assuming an eight-year life of the EV and using the *Emissions Gap Report's* \$130 per tonne threshold as a benchmark for decision-making about alternate investments in GHG reductions.

Figure 3 shows that as the subsidy level increases, the cost of the carbon savings marches higher. The figure also illustrates that the provinces with the highest equivalent annual emissions reductions will have the most cost-efficient subsidies. Note that this analysis was prepared prior to the introduction of the federal \$5,000 EV purchase subsidy; it compares the relative cost and impact of a notional \$1,000, \$5,000, and \$10,000 EV subsidy in each province against potential alternative public investments to reduce emissions. Its findings suggest the ineffectiveness of layering an additional subsidy amount onto jurisdictions whose electricity generation mix makes it either counter-productive or unreasonably expensive to implement an EV consumer subsidy.

Figure 3: Lifetime Cost of GHG Emissions Reductions by EV Subsidy Level by Province



Price per tonne CO₂e reduction of various EV subsidies (Honda Civic vs Hyundai Ioniq EV)



Price per tonne CO₂e reduction of various EV subsidies (Toyota Prius vs Hyundai Ioniq EV)

Source: Thorne and Hughes (2019).

EQUITY

In 2023, many EVs still command a price premium over their conventional equivalents. However, the increased availability of different classes of EVs in Canada (35 EV models are eligible for the federal iZEV program and 50 for the BC program) implies that buyers committed to purchasing an EV can now do so at a range of price points. (As of February 2023, according to Canada Drives (Undated b), eight EVs are priced under \$50,000 in Canada). As noted in the literature (Lemphers, Bernstein, Hoffmann and Wolfe, 2021), and also in the example of Ontario, the presence of an incentive has varying degrees of influence on purchasing decisions. This implies that many buyers with both motivation and means are likely to proceed with their purchase regardless of the generosity of government incentives.

Taking advantage of an incentive—once it is in place—is of course entirely rational for any purchaser, regardless of financial ability. However, a poorly designed program is not rational for society as a whole as it results in undesirable distributional effects that have been observed in the US literature as well as in Canada. In a 2016 study, economists from the University of California at Berkeley found that over the preceding decade, approximately 90 percent of US federal EV purchase credits went to those in the top income quintile (Borenstein and Davis, 2016). A 2019 analysis found that, without a subsidy, only 18 percent of Canadian households were “financially suited” to purchasing an EV, and that purchasers of small EVs (Ford Focus and Fiat 500e) had average annual household incomes of \$145,000 to \$199,000 (cited in Gessaroli, 2022). Since 2019, more EVs at lower price points have become available in Canada, suggesting that these analyses should be updated.

However, equity concerns remain. Acknowledging these problems with the EV subsidy design, certain Canadian jurisdictions have introduced two types of parameters: an eligibility price ceiling by EV type, and an income test for buyers.

The federal iZEV program has price ceilings of \$55,000 to \$65,000, depending on the make and model of EV. Provincial programs also set price ceilings, for example \$55,000 to \$70,000 in BC, and \$65,000 in Quebec. But on its own, the vehicle price ceiling does not improve the equity of the policy as it does not address the ability of the household to cover the vehicle cost. To address this limitation, BC introduced an income threshold in 2022 for which buyers must qualify before making their purchase. Individuals with incomes under \$80,000 are eligible for the full \$4,000 provincial incentive; those with incomes of \$100,000 and over do not qualify.

The income test applied by British Columbia addresses aspects of the equity problem in EV subsidies. While we recommend discontinuing the federal EV subsidy, if the iZEV program continues to its original sunset date of 2025 (see Conclusion) then the government should institute an income test for the remaining life of the program. Without this amendment to the policy it will remain the perception, and in part the reality, that subsidies for EV purchases continue to involve a transfer from taxpayers of varying income levels to higher-income individuals and households—many of whom are likely to make an EV purchase even without government subsidies.⁷

7 See Statistics Canada (2023), Table 20-10-0024-01, for Ontario-specific sales of EVs (consisting of battery EVs, hybrid EVs, and plug-in-hybrid EVs). By 2022, battery EVs represented 62 percent of all EV sales in Ontario, while in 2017 they accounted for 22 percent of all EV sales.

CONCLUSION

We acknowledge the policy goals underpinning the decisions by the Canadian government and some of the provinces to subsidize the purchase of EVs. To change consumer behaviour and engineer a rapid decarbonization of passenger transportation, the federal government has clearly paid heed to the advice offered by climate change and environmental NGOs: embrace an all-of-the-above policy approach to GHG abatement while paying little attention to either taxpayer costs or marginal abatement costs. In recent years Canada has introduced an escalating carbon tax (backstop), EV purchase incentives, renewable fuel standards, and an EV sales mandate (on manufacturers) in a bid to quickly reduce passenger vehicle carbon dioxide emissions.

We infer that three strands of the federal government's plan are probably intended to work together: 1) high EV consumer subsidies through the iZEV program that is to end in 2025; 2) the first phase of the EV sales mandate coming into effect in 2026; 3) backed by the subsidized greening of Canada's electricity grids between now and 2035—by which time all new passenger vehicle sales in the country are expected to be electric.

There are both policy problems and real-world problems with the EV subsidy programs and their role in lowering Canadian GHG emissions. Policy overlaps are leading to inefficiencies, waste, and GHG reduction policies that are less effective than they could be. The cost of avoided emissions remains high in the passenger transportation sector. The pace and scale of real-world changes needed to “green” and expand electricity production and transmission and to ramp up the production of EVs will pose formidable challenges for policymakers in many jurisdictions, including Canada, particularly given the existence of legislated timelines for achieving large absolute reductions in both total and sectoral emissions that are essentially politically dictated (van Kooten, 2021).

“Policy overlaps are leading to inefficiencies, waste, and GHG reduction policies that are less effective than they could be.”



The policy disconnects in Canada include layering an EV subsidy over the broad-based and steadily rising Canadian carbon tax, rendering less effective the price and behaviour signals the tax sends to drivers, particularly to new vehicle purchasers. As discussed above, Canadian EV

subsidies at the federal and provincial and territorial levels surpass most benchmarks of societally acceptable investments in GHG emissions abatement. GHG reduction programs costing—depending on the province—between \$350 and \$857 per tonne of avoided emissions, with the benefits mainly accruing to EV buyers (most of whom arguably can afford to purchase such vehicles without taxpayer help), should be revamped, with the taxpayer-financed resources earmarked for these programs re-allocated to more cost-effective climate policies. Alternatives could include large scale solar and land-based wind projects, natural gas projects with carbon capture and storage, and nuclear power generation. Or, governments could decide to devote fewer fiscal resources to GHG mitigation and perhaps more to adaptation.

The second policy disconnect is between the EV incentive and the EV production and sales mandate. Logic suggests that if one is in place the other is not needed. If a production and sales mandate is indeed deemed necessary, which we doubt given the relatively rapid introduction of new EV makes and models at various prices, capabilities, and distance ranges, the consumer subsidy should be wound down expeditiously. Given the national EV sales mandate, provincial subsidy programs—even in jurisdictions where the electricity generation mix favours them—should be discontinued no later than the federal program.

More broadly, we have significant concerns with Canada's revised social cost of carbon and the five-fold increase in the estimates of the cost per tonne of Canada's emissions. The methodology adopted by

Environment and Climate Change Canada (absent any identifiable public process) mirrors the US Environmental Protection Agency's present updating of the United States' SCC, which has yet to be formally adopted by the Biden Administration. Much of the public in Canada and around the world is of the view that climate change is increasingly affecting important aspects of life (hence behaviour change like increased EV adoption), so a higher SCC may be warranted. However, Canada could be vulnerable to being out of step *in practice* with a future formally adopted US SCC that is lower than that proposed by EPA (2022), thereby adding to the comparative attractiveness of the US as an investment jurisdiction (especially given the enormous subsidies on offer under the US Inflation Reduction Act). Canada's hasty adoption of a dramatically higher SCC creates a permissive setting for the pursuit of very costly government-mandated GHG mitigation measures.

“In the real world... it is not yet clear whether automakers can or will meet Canada's 2035 EV sales target.”



In the real world, leaving aside the availability of critical minerals and other inputs required to produce and procure the requisite number of EVs that consumers will demand in North America, Europe, and

elsewhere in the coming years, it is not yet clear whether automakers can or will meet Canada's 2035 EV sales target, or even the European Union's. In March 2023, Germany made a last-minute objection to the EU's commitment to 100 percent vehicle electrification by 2035, based on the automotive industry's case that net-carbon neutral fuels operating internal combustion engines still have a place in Europe's (and therefore the world's) light duty transportation mix. Italy, Hungary, and Poland—all with substantial automotive industries—agreed with Germany. By the end of March, the EU had agreed to incorporate net-carbon-neutral synthetic liquid fuels in the mix for pre-existing internal combustion vehicles post-2035 (Agence France Presse, 2023).

This development leaves the EV mandate question open in the minds of some auto industry executives here in Canada, including CEO of the

Canadian Vehicle Manufacturers Association Brian Kingston (2022), as well as in the minds of policy analysts who wonder about Canada's ability, with neither a track record of expeditiously deploying large-scale projects to green the electricity grid nor a realistically scaled EV manufacturing base, to enable or enforce a 100 percent EV sales policy by 2035.

Tangentially, the analysis in this essay also raises questions about the future of biofuel and renewable fuel production in Canada, which in recent years has been shaped by renewable fuel mandates federally and in some provinces. Unless light passenger trucks are still permitted to run on liquid fuels that withstand cold Canadian winters (the category projected by the CD Howe Institute to have the largest gap between actual and targeted emissions reductions in 2030, partly due to trucks representing a larger share of passenger vehicle sales in recent years), it is hard to see the logic of the investments to date by taxpayers and the private sector in a fuel type that may disappear before meeting its full utilization potential in the transportation mix.

Finally, Canada's decision to devote significant fiscal resources to electrifying the transportation sector raises questions about the policy justification for the federal backstop carbon pricing system, which will lead to a steady escalation of the applicable carbon tax across the country over the next several years. Many economists who support pricing GHG emissions due to the "negative externality" these emissions create have pointed to the relative efficiency and transparency of carbon pricing compared to other, more complex policy instruments such as consumer subsidies, tax incentives for industry, government regulations, and product standards (e.g., Metcalf, 2022; Dahlby et al., 2019; McKittrick, 2016). Indeed, the Canadian government itself states that "[p]utting a price on pollution is widely recognized as the most efficient means to reduce greenhouse gas emissions" (Environment and Climate Change Canada, 2023).

Yet the government's actions belie the claim that efficiency is the main factor shaping federal climate policy. Indeed, rather than using carbon pricing as the primary mechanism to aid in moving to a lower-carbon economy, the government is deploying an ever-lengthening list of fiscal, regulatory, and other policies and programs in pursuit of this goal, including hefty subsidies

for the purchase of EVs. The net result of this shambolic “all-hands-on-deck” approach will be a higher aggregate societal cost to achieve any given quantum of emissions reductions (Canadian Chamber of Commerce, 2019). This is because not only will Canadians be paying more for fossil fuel energy in the coming years as the carbon tax rises; they will also be paying, again and again, in the form of taxpayer-financed EV purchasing subsidies and incentives, significant government expenditures on EV charging stations and infrastructure, and tens of billions of dollars of government funding to support the expansion and transmission of carbon-free electricity. And that is before one considers the enormous investment and production subsidies that the federal and some provincial governments are now showering on EV and battery manufacturers. One thing is certain: the total economic bill for the politically dictated shift to EVs will be considerably greater than elected officials in Ottawa have acknowledged so far.

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