Rethinking Quebec's Support for Electric Vehicles

HOW TERMINATING EV SUBSIDIES CAN STRENGTHEN QUEBEC'S CLIMATE POLICY

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EXECUTIVE SUMMARY

Quebec has adopted ambitious targets for reducing greenhouse gas (GHG) emissions by 2030, and its economy-wide cap-and-trade system is designed to achieve these targets in a cost-effective manner. The system is working well and is linked to California with a common carbon price across the two jurisdictions, currently just above $22 per tonne. The revenues raised from the auction of cap-and-trade allowances are collected in the province's Green Fund, which is then used to finance various other policies in the fight against climate change.

Quebec's GHG emissions have fallen gradually since 1990, but those in the transportation sector continue to rise, and threaten the achievement of the province's 2030 target. Given the intuitive appeal of replacing traditional vehicles (powered by gasoline or diesel) with electric

vehicles (EVs) to reduce GHG emissions, the government has for several years offered generous subsidies to EV purchasers, though this policy has had only limited success in driving their widespread adoption. On Quebec's roads today, fewer than 2% of light vehicles are EVs.

Despite their intuitive appeal in the fight against climate change, EVs and EV subsidies are not as attractive as many think. The lifecycle emissions for EVs are lower than for traditional vehicles, but the environmental payoff only exists if the EVs are driven for several years. EV subsidies use scarce public funds, are often received by high-income purchasers who would have bought the vehicle even without the subsidy, and have only limited effectiveness in driving Quebecers' overall adoption of EVs. Perhaps most important, the nature of Quebec's well-functioning cap-and-trade system implies that any additional adoption of EVs by Quebec drivers will not lead to additional emissions reductions for the province as a whole; any reduction in transportation emissions will simply be replaced by an increase in emissions in other parts of the economy.

The upshot of this analysis is that Quebec's EV subsidies are both very costly and ineffective in reducing the province's GHG emissions, and for this reason we recommend phasing them out over the next few years. If the government determines that the non-climate-related benefits of EVs are deserving of government support -- though at a more modest level -- we provide four alternative policies to consider, each of which is likely a more cost-effective means of encouraging EV adoption than the use of EV subsidies.

The funds currently available inside the Green Fund are not fully utilized, reflecting the difficulty of finding projects with a genuine prospect of reducing GHG emissions in a cost-effective manner. If the government follows our recommendation to phase-out the EV subsidies, this will free up over $200 million annually in the Green Fund. With gradual increases in the carbon price expected in the near future, there will be even more money available in the Green Fund. Spending this money responsibly requires careful consideration.

We examine the benefits and costs of three possible ways to use these funds -- funding innovation in the clean-tech sector, improving Quebec's public transportation infrastructure, and issuing "climate dividends" to Quebec residents. Any or all of these options can be funded without affecting the government's other spending or tax policies. The first two options are directed at reducing GHG emissions over the longer run, but their most important benefit is in making it easier for Quebec's households and businesses to adapt to a lower-emissions economy. The third option is directed at making it more politically feasible for the province to take even more aggressive climate action -- if it chooses to do so.

OUR RECOMMENDATIONS

Phase-Out EV Subsidies

Decrease EV subsidies by $2,000 each year, to be completely phased out by 2025 -- freeing up over $200 million annually.

IF THE QUEBEC GOVERNMENT IS COMMITTED TO CONTINUING ITS SUPPORT FOR EVS, THE FOLLOWING FOUR POLICY OPTIONS ARE PREFERABLE TO EV SUBSIDIES:

Increase the Stringency of the ZEV Mandate

The current ZEV mandate compliance credits should become more stringent by applying to a larger percentage of ZEV sales.

Require Charging Stations for New Buildings

All new commercial and residential buildings should be required to have 20% of the associated parking spaces equipped with EV charging capacity, while the remaining 80% of spaces must support the installation of charging stations in the future.

Extend HOV/EV Lanes

Since EVs are eligible to use HOV lanes, extend HOV/EV lanes in and out of major cities.

Scale-Up the Existing EV Information Campaign

The government should scale up its existing *Roulons électrique* information campaign and extend it until at least 2025.

FOR A MORE EFFECTIVE USE OF THE EXISTING GREEN FUND, THE GOVERNMENT SHOULD CONSIDER THE FOLLOWING POLICY OPTIONS:

Allocate Funding to Support Clean-Tech Innovation

The government should allocate funding to mid-stage clean-tech innovation to support businesses in achieving commercialization, reducing emissions, and accelerating Quebec in becoming an innovation hub.

Allocate New Funding to Public Transit Infrastructure

The government should allocate funds to support new public transit projects in urban areas and their suburbs.

Provide Quebecers with a "Climate Dividend"

The government should provide Quebec residents with a regular "Climate Dividend" to encourage climate action on a household level, increase the political feasibility of a more stringent cap-and-trade system, and support people during the economic recovery.

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SECTION 1

THE CURRENT QUEBEC CONTEXT

1.1 Quebec's Climate Plan

Acknowledging that the fight against climate change is of central concern to Québecers, the Quebec government has made commitments to mitigate the impact of climate change on people, their livelihoods and our economy. These commitments are detailed in the 2013-2020 Climate Change Action Plan (CCAP), the main tool by which Québec is framing its climate-change action.[1] The CCAP budget is taken from the province's Green Fund, which is funded by the revenue from the sale of allowances in Quebec's cap-and-trade system.

The CCAP intended to reduce the province's GHG emissions by 20% from the 1990 levels by 2020.[2] In December 2019, the government announced that it expected to miss that target, having then reduced emissions by only 8.7% from 1990 levels.[3] (Not surprisingly, current estimates suggest that the economic downturn caused by the Covid-19 pandemic will significantly reduce emissions, but this effect will last only as long as the pandemic itself.[4])

Recently, the Quebec government announced a new budget of $6.2 billion over 6 years to fight climate change, a 50% increase from what was initially planned in the 2013-2020 CCAP. Approximately two-thirds of this funding will come from the Green Fund (detailed below).

The Quebec government is currently drafting its 2030 Plan for a Green Economy (PGE), which will replace the CCAP. The government has indicated that, relative to1990 levels, it intends to reduce GHG emissions by 37.5% by 2030 and by 80% - 95% by 2050.[5] Such emissions reductions will not just occur "naturally"; greater ambition in terms of emissions reductions will require either additional or more stringent policies relative to the status quo.

1.2 Transportation Emissions

Transportation is the sector with the highest GHG emissions in Quebec, responsible for 43% of total emissions; it is followed by heavy industries at 25% and by buildings at 14%.[6] Half of

[1] Environnement et lutte contre les changements climatiques, "2013-2020 Climate Change Action Plan", Gouvernement du Québec. Retrieved from: http://www.environnement.gouv.qc.ca/changementsclimatiques/plan-action-fonds-vert-en.asp
[2] Government du Quebec, "Le Quebec En Action Vert 2020", 2012 Retrieved from: http://www.environnement.gouv.qc.ca/changements/plan_action/pacc2020.pdf
[3] Richer, Jocelyne, "GES: Québec confirme que la cible de réductions en 2020 ne sera pas atteinte", L'actualité. December 18, 2019. Retrieved from: https://lactualite.com/actualites/ges-quebec-confirme-que-la-cible-de-reduction-en-2020-ne-sera-pas-atteinte/
[4]Blais, Anabelle, " Québec pourrait atteindre sa cible de réduction des GES", Le journal de Montréal, May 19, 2020. Consulté à l'adresse suivante: https://www.journaldemontreal.com/2020/05/19/quebec-pourrait-atteindre-sa-cible-de-reduction-des-ges
[5] Gerbet, Thomas, "Plan vert 2030: voici tout ce que le Québec promet", Radio-Canada, June 2020. Retrieved from: https://ici.radio-canada.ca/nouvelle/1713125/plan-economie-verte-2030-quebec-ges-environnement
[6] Canada Energy Regulator, " Provincial and Territorial Energy Profiles – Quebec," Government of Canada, June2020. Retrieved from: https://www.cer-rec.gc.ca/nrg/ntgrtd/mrkt/nrgsstmprfls/qc-eng.html?=undefined&wbdisable=true

transportation emissions come from light vehicles: cars and light trucks.[7] While Quebec's total GHG emissions have declined by 9% since 1990 (see Figure 1), emissions from the transportation sector have *increased* by over 6%.[8] This pattern likely reflects the inherent difficulty and associated high costs of reducing emissions from the transportation sector as compared with other sectors; we say more about this below.

According to the CCAP, two-thirds of the revenue from the Green Fund is to be used to reduce transportation emissions. Policies introduced as part of this plan include emissions standards for new light vehicles[9], maximum speed limits for trucks, and financial incentives to encourage the purchase of hybrid and electric vehicles (EVs).

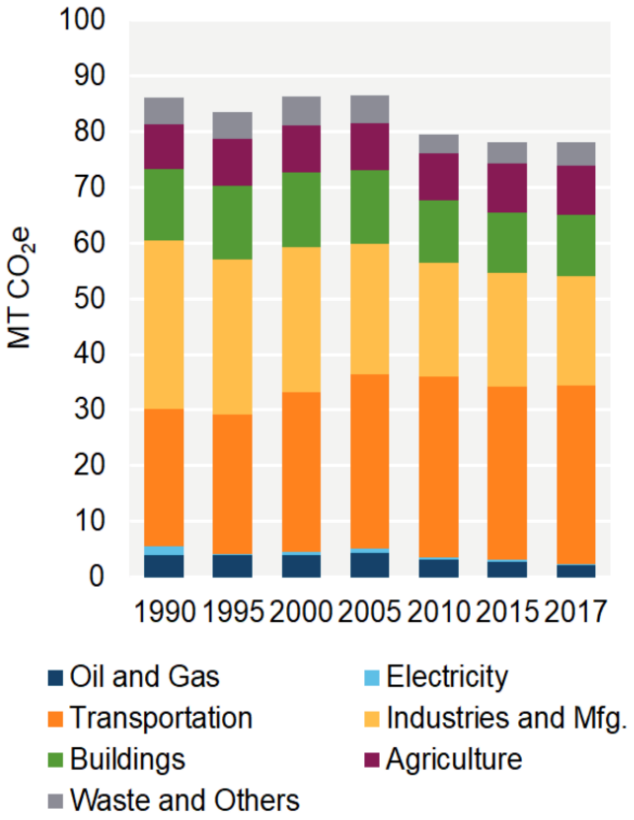

Figure 1: Transportation Emissions by Sector

The policies in the CCAP are described in the 2011-2020 *Electric Vehicle Action Plan* (EVAP). The EVAP sets an ambitious target for one-quarter of new vehicles purchased in 2020 to be EVs, which would bring the entire EV fleet to 118,000 vehicles.[10] Looking further ahead, the EVAP aims to have 1.2 million EVs on Quebec's roads by 2030, and also commits to the electrification of 95% of all public transit infrastructure.

Quebec has failed to reach its 2020 EV target. Hybrid and electric vehicles represented only 7% of total light vehicle purchases in 2019 and there are fewer than 80,000 EVs on the road today. Despite the relatively low adoption of EVs in Quebec, the 2030 Plan for a Green Economy (PGE) predicts that the transportation sector will account for 57% of the province's GHG emissions reductions. It is not clear which policies can be best used to achieve this objective. The government may choose to support the gradual electrification of the transportation sector,

[7] Government of Quebec, "Motor Vehicle Greenhouse Gas Emissions," Ministry of Sustainable Development, Environment, and Fight Against Climate Change, August 2020. Retrieved from: http://www.environnement.gouv.qc.ca/changements/ges-en/reglement.htm
[8] Canada Energy Regulator, "Provincial and Territorial Energy Profiles – Quebec,"
[9] Government of Quebec, "Motor Vehicle Greenhouse Gas Emissions,"
[10] Government of Quebec "Plan d'action 2011-2020 sur les véhicules électriques (Gouvernement du Québec)", 7 Avril 2011. Retrieved from: http://conf.tac-atc.ca/english/annualconference/tac2012/docs/session18/hotte.pdf

including new public-transit buses, school buses, taxis, and heavy vehicles. The government may also provide financial support for the purchase of heavy EVs. These kinds of policies must be assessed for their effectiveness at reducing GHG emissions, and the costs at which they operate.

1.3 Québec's Cap-and-Trade System

The Quebec government has stated its objective of decreasing GHG emissions at the lowest possible cost to taxpayers and the economy.[11] Toward this end, in 2013 the province implemented a cap-and-trade system to reduce GHG emissions. This system covers approximately 77% of the province's total emissions, including those from the transportation sector.[12] The system imposes an upper limit or "cap" on covered emissions, with the cap gradually declining over time. Emissions permits or "allowances" are then issued or auctioned to the firms included in the system. These allowances are tradable in markets, and this trading results in a "carbon price." Within the cap-and-trade system there will be two types of firms. Some will sell their allowances and choose to decrease their emissions; others will purchase allowances and choose to continue their emissions.

Since 2014, Quebec's cap-and-trade system has been linked to California through the Western Climate Initiative (WCI). This linkage allows the common carbon price to be determined by the market spanning the two jurisdictions, with allowances being bought and sold across the jurisdictional boundary.

Quebec's cap-and-trade system increases the prices of goods and services throughout the economy, depending on their carbon intensity. The price of a litre of home-heating oil increases by more than a kilowatt hour of electricity because of the higher carbon content of the former. These price increases incentivize all firms and households to recognize the cost of their GHG emissions, encouraging innovation and behavioural change to reduce their own carbon footprints. Over time, as new technologies are developed and behaviours are modified, Quebec's GHG emissions will fall.

There is widespread agreement among economists that carbon pricing, whether through a cap-and-trade system or through a carbon tax, is the lowest-cost way for any economy to reduce its GHG emissions.

1.4 Quebec's Green Fund

Created in 2006, the Green Fund was established to promote sustainable development in Québec by protecting the environment, preserving biodiversity and fighting climate change.

[11] Government of Quebec, "Your Budget, Your Plan 2019-2020," Ministry of Finance, March 2019. Retrieved from: http://www.budget.finances.gouv.qc.ca/budget/2019-2020/en/documents/BudgetPlan_1920.pdf
[12] WCI, Inc. "Participating Jurisdictions Overview", July 7, 2020. Retrieved from: https://wcitestbucket.s3.us-east-2.amazonaws.com/amazon-s3-bucket/participatingjurisdiction-comparativetable-en.pdf

Approximately two-thirds of the province's $6.2 billion sustainable development budget comes from the Green Fund.

The Green Fund receives revenues from: the quarterly auctions of GHG allowances within the cap-and-trade system; royalties for the disposal of residual materials; and royalties payable for the use of water. Two-thirds of expenditures financed by the Green Fund are used on programs to reduce GHG emissions from the transportation sector. (See Appendix 5 for a description of the types of projects funded by the Green Fund).

Under each sponsored project, municipalities, businesses and organizations can receive money directly from the Green Fund. From the analysis of supported programs and recipients, it is unclear how and by how much each of the supported projects contributed to the province's emission-reduction targets.[13] [14]

The Green Fund is a fiscal tool, not a program. The Green Fund Management Board enters into agreements with partner agencies, including businesses, organizations, municipalities, and individuals. The Green Fund's expenditure and investment forecasts are tabled and adopted by the National Assembly.

In October of 2019, the Government of Québec introduced Bill 44 to simplify the governance of the Green Fund by restoring full ministerial responsibility, and by refocusing the Fund exclusively toward the fight against climate change. No consensus has yet been achieved on this bill, which has been heavily contested by opposition parties.

In early 2020, the *Commissaire au développement durable* released an audit report, pointing to a lack of transparency and due process in assessing the environmental impact of projects financed by the Fund, including their contribution to achieving emissions-reduction targets. The Commissaire concluded that the Fund's governance bodies have not created the conditions necessary for its effective use; in particular, they have not provided clear direction to departments and agencies toward a common goal.[15] In addition, a considerable portion of the Green Fund is currently not being spent at all, and thus represents idle resources the government could use to spur economic development in the province.

1.5 The Purpose of this Report

Quebec's current climate strategy and use of the Green Fund do not reflect the province's clear commitment to reducing GHG emissions at the lowest possible economic cost. Here we examine the scope for adjusting policies to better use the Fund's scarce resources and to achieve more emissions reductions at a lower overall economic cost. Specifically, this report provides a critical analysis of existing EV subsidies, currently one of the main climate policies in Québec.

[13] List of programs can be seen at: http://www.environnement.gouv.qc.ca/cgfv/programmes.htm
[14] List of recipients can be viewed at: http://www.environnement.gouv.qc.ca/cgfv/documents/fiches-suivi/index.htm
[15] Vérificateur général du Québec "Rapport du vérificateur général du Québec à l'assemblée nationale", Juin 2020. Retrieved from: https://www.vgq.qc.ca/Fichiers/Publications//rapport-cdd//164//cdd_tome-juin2020_web.pdf

Section 2 of the report examines the intuitive appeal of relying on EVs to achieve a major part of Quebec's targeted emissions reductions. This intuition motivates the current set of policies designed to increase EV adoption. Section 3 explains why EVs are actually less attractive than they initially appear, and why EV subsidies are a relatively ineffective way to reduce GHG emissions, especially within the Quebec context of a well-functioning cap-and-trade system. In Section 4 we explain our primary recommendation for phasing-out Quebec's EV subsidies, but we also present four alternative policies that are worth considering if the government chooses to support EV adoption for their non-climate-related benefits. Section 5 examines three specific climate policies that the government should consider as a means of spending the money freed up by the phase-out of the EV subsidies and the considerable unused financial resources currently inside the Green Fund. The final section offers a brief summary of our policy recommendations. This report is intentionally written so that sections can be read independently of others.

1.6 Note on Methodology: The Importance of Policy Cost-Effectiveness

In assessing current and recommended policies, this report focuses on cost-effectiveness -- which means achieving any given objective at the lowest possible cost. Since climate policies have real implications for jobs, standards of living, and economic growth, cost-effectiveness is particularly important in developing these policies. While cost-effectiveness is not, and should not be, the only criteria to use in crafting government policies, careful consideration should be given to it, especially in the current economic context.

To assess a policy's cost-effectiveness, two different costs are considered: fiscal costs and economic costs. The fiscal cost represents the government's financial requirement to implement the policy. From the government's perspective, any dollar spent on one policy must be financed either by new taxes, new borrowing, or reduced spending on other priorities. The second cost is the broader economic cost imposed on individuals, businesses, and the economy. A specific policy or regulation may have few implications for the government's budget even while it imposes a large cost on businesses and households.

The cost-effectiveness of environmental policies can be assessed by measuring the cost per tonne of emissions reduced. For example, Quebec's cap-and-trade system currently generates a carbon price of approximately $22 per tonne, meaning that it costs the emitter (no more than) $22 to reduce one tonne of GHG emissions. In contrast, existing research suggests that Quebec's EV subsidies reduce GHG emissions at a much higher cost of about $395 per tonne. We explain in this report why EV subsidies are such an expensive way to reduce GHG emissions.

Resources are always scarce, for any economy and for any government. In the face of such scarcity, minimizing the cost of climate policies should be a central priority for any government, not least because it enhances the political viability of ambitious climate policy. A reliance on high-cost policies could lead members of the public to ultimately reject these policies, and even to reject

climate action more generally. Durable climate action that achieves greater GHG reductions is most likely to occur with policies that aim at minimizing their costs to consumers and businesses.

To supplement the policy assessment, particularly when it comes to EV adoption, a survey has been commissioned to Abacus Data to better understand the Quebec public opinion surrounding EV vehicles and their relevant policies. The survey, with a sample of 1,000 Quebec residents, offers a deeper insight into the perceptions of Quebecers on EVs, on their purchasing behaviours, and on their attitudes surrounding existing or future policies to enhance EV adoption. Appendix 6 presents a detailed description of the key takeaways.

SECTION 2

THE INTUITIVE APPEAL OF ELECTRIC VEHICLES

As shown in Figure 1 above, over 40% of Quebec's GHG emissions come from the transportation sector, with light vehicles amounting to half of these emissions.[16] [17] Between 1990 and 2016, despite a decline in Quebec's overall emissions of 9%, emissions from the transportation sector increased by 6.1%.

Given these emission trends, it should not be surprising to see a focus on policies aimed specifically at the transportation sector, including a strong push to encourage the adoption of EVs. In principle, EVs generate zero emissions when used, and thus substituting internal combustion engines vehicles (ICEs) with EVs is viewed as a sure step toward reducing emissions. In addition, given the province's abundance of low-emissions hydro power, Québec provides the ideal conditions for reducing GHG emissions through the electrification of passenger vehicles.[18]

2.1 Barriers to EV Adoption

Whatever social benefit may be associated with the greater use of EVs, businesses and households have not yet been convinced of the virtues of purchasing and driving them. Despite considerable technological improvements, ongoing price declines, and generous government subsidies, EVs have not been as widely adopted by consumers as initially anticipated by policymakers. Electric vehicles currently represent less than 2% of all light vehicles in Quebec.

Experts have indicated that several barriers or "market failures" are likely preventing a greater adoption of EVs. The primary market failures are:

Price Differential

The GHG emissions generated by ICEVs represents a negative externality for society. The cost of these emissions is not reflected in the market price of ICEVs faced by consumers, which makes their price artificially low as compared with the market price of EVs, with lower EV uptake a natural result. If drivers of ICE vehicles were required to internalize all these pollution costs, EVs would be relatively much more affordable.

Network Externality

A network externality occurs when benefits to an individual user of a product depend on how many others are also using the product.[19] Issues of limited supply and limited models can directly lead to low EV uptake. Additionally, there is an indirect network externality between charging infrastructure and EV uptake, where EV uptake depends on sufficient existing charging

[16] Government of Québec, "Inventaire québécois des émissions de gaz à effet de serre en 2016 et leur évolution depuis 1990", Ministère de l'environnement et la Lutte contre les changements climatiques, 2018. Retrieved from: https://docs.google.com/document/d/1dyb3a4I3t9uKIP32rUDHhORWAg1E8qSAqPyjk9a03jA/edit
[17] Government of Quebec, "Motor Vehicle Greenhouse Gas Emissions"
[18] Government of Quebec, "Your Budget, Your Plan 2019-2020"
[19] Canada's Ecofiscal Commission, "Supporting Carbon Pricing: How to Identify Policies That Genuinely Complement an Economy-Wide Carbon Price," 2017, p.12. Retrieved from:https://ecofiscal.ca/reports/supporting-carbon-pricing-complementary-policies/

infrastructure, and charging infrastructure depends on the number of total EV users, creating a "chicken-and-egg" problem.

Knowledge Spillovers

Though society ultimately reaps the benefits of the innovative technologies used in EVs, these innovations are not moving fast enough to increase EV adoption in the short term. If innovative firms are unable to capture all the benefits from their innovations -- because some of the new knowledge "spills over" to and is captured by competing firms -- then they are less likely to innovate in the first place. With less overall innovation, the industry as a whole will be less successful in increasing its scale, decreasing the selling price, and convincing consumers to purchase EVs.[20]

Limited Consumer Knowledge

Many consumers do not buy EVs because they lack sufficient information about them. Incomplete information and lingering perceptions around operating costs, battery range, and accessibility of charging infrastructure remain significant barriers to EV adoption.

2.2 Existing EV Policies in Quebec

Over the past decade or so, these market failures have led many governments to actively support the adoption of electric vehicles.[21] Policies have been designed to reduce the price differentials between ICEs and EVs, to support the charging network infrastructure, and to increase consumer awareness of the technology. Quebec has been part of this global trend.

Québec has a series of policies and regulations aimed at increasing both the supply of and demand for EVs, namely a subsidy program and the Zero-Emission Vehicle (ZEV) mandate. In addition, the Canadian government has emissions regulations for light vehicles which apply in Quebec. These policies are briefly described below.

2.2.1 EV SUBSIDIES

The *Roulez vert* program supports consumers in purchasing new and used EVs and the installation of charging stations. Under the *Roulez vert* program, the Québec government offers individuals, businesses and municipalities a rebate of up to $8,000 for the purchase of a new EV. (The actual subsidy in each case depends on the model, year, battery capacity, and year of purchase; details of the program are summarized in Appendix 2.).[22] The subsidy applies only for EVs whose Manufacturer's Suggested Retail Price (MSRP) is below $60,000.[23]

[20] Canada's Ecofiscal Commission, "Supporting Carbon Pricing", p.13.
[21] Canada's Ecofiscal Commission, "Supporting Carbon Pricing", p.10.
[22] Government of Quebec, "New Vehicle Rebate," Energy Transition Quebec, accessed August 2020. Retreived from: https://vehiculeselectriques.gouv.qc.ca/english/rabais/ve-neuf/programme-rabais-vehicule-neuf.asp
[23] This is a new threshold since the beginning of 2020. Before that, cars with an MSRP below $75,000 were eligible to receive the subsidy.

In the most recent Quebec budget, $434 million is dedicated to the *Roulez vert* program for the fiscal years 2019-20 and 2020-21. Note that the Canadian government started offering a similar subsidy in 2019. At a value of $5,000, the federal subsidy can be combined with the provincial one, for a total purchasing incentive of up to $13,000.

2.2.2 THE ZEV MANDATE

In 2019, the Quebec government also enacted the ZEV Act, which requires vehicle manufacturers to sell or lease a minimum number of zero-emission vehicles (ZEVs) through a system of tradable credits. The ZEV mandate was implemented to spur the supply of EVs to the Quebec market. Each sale or lease of an EV in Quebec earns the auto manufacturer credits (more credits are allocated for longer-range EVs) which can be sold on an internal market. Automakers that have accumulated surplus credits can sell them to other automakers that wish to avoid paying the penalties stipulated by the regulation.[24]

2.2.3 CANADA'S PASSENGER AUTOMOBILE AND LIGHT TRUCK GHG EMISSIONS REGULATIONS

This federal policy regulates emissions from ICE vehicles and limits the CO2 emissions per mile for manufacturers' vehicle fleet, with increasingly stringent targets. This regulation requires manufacturers' average fuel consumption to meet a particular threshold and thereby incentivizes fuel efficiency to reduce emissions in the transportation sector. By gradually forcing an increase in fuel efficiency, the regulation is predicted to dampen gasoline consumption in Quebec. The regulation is harmonized with the U.S. Corporate Average Fuel Economy (CAFE) standards.

2.2.4 OTHER POLICIES

The Quebec government plans to invest an additional $27 million over five years to fund EV innovation, supporting research, innovation and marketing. The government will also invest $18 million over five years to develop EV battery recycling in the province.[25] [26] In addition, the Quebec government recently supported the information campaign called *"Roulons électrique"*, a joint initiative from Équiterre and Transition Énergétique Québec, aimed at disseminating information to potential EV buyers.

[24] Government of Quebec, " The zero-emission vehicle (ZEV) standard," Ministry of Sustainable Development, Environment, and Fight Against Climate Change, April 2020, retrieved from: http://www.environnement.gouv.qc.ca/changementsclimatiques/vze/index-en.htm

[25] Government of Quebec, "Your plan, your budget 2019-2020"

[26] Late in August 2020, media outlets published articles regarding the government's intention to dedicate approximately $2 billion for battery construction and recycling projects in the province.

2.2.5 HAVE THESE POLICIES DRIVEN THE ADOPTION OF EVS?

These policies have helped create an initial market for EVs in Québec, although not to the extent intended by policymakers. Between 2012 and 2017, there was a small upward trajectory in annual EV sales, with the total fleet barely reaching 10,000 before 2014. Significant increases in EV sales were observed in 2019, coinciding with the launch of the federal subsidy.[27] [28] [29] EVs represented only 7% of total passenger vehicles sold in Quebec in 2019.

As of June 2020, there were a total of 76,357 EVs on Quebec's roads -- less than 2% of the total registered light vehicles in the province. A majority of these EVs are in urban areas, with Montreal in the forefront. (See Appendix 7 for some details on Quebec's EV market.)

Given the intuitive appeal of using EVs to reduce GHG emissions, and how this appeal has led to the implementation of policies designed to generously encourage EV adoption in Quebec, we need to ask why EVs continue to languish as a "niche" product. Is this appealing intuition missing some fundamental reality?

[27] Transport Canada, "Sale of zero-emission vehicles jump after launch of federal incentive program," Government of Canada, August 2019. Retrieved from: https://www.canada.ca/en/transport-canada/news/2019/07/sale-of-zero-emission-vehicles-jump-after-launch-of-federal-incentive-program.html
[28] Government of Quebec "Statistical Data: Evolution of the Roulez vert program". 2020. Retrieved from: https://vehiculeselectriques.gouv.qc.ca/rabais/statistiques/infographie-programme-roulez-electrique.asp
[29] The economic recession caused by the Covid-19 pandemic is expected to curb the increased demand for EVs, as Quebecers' purchasing power has decreased, especially affecting the spending on durable goods. March and April 2020 sales provide early evidence of this.

SECTION 3

SOME INCONVENIENT TRUTHS ABOUT EVs AND EV SUBSIDIES

The intuition for replacing highly emitting fossil-fuel-powered vehicles with zero-emission electric vehicles is straightforward since such replacement seems to present an easy opportunity to reduce GHG emissions in Quebec. However, when we consider the environmental performance of EVs over their *entire lifecycle*, and also the *interaction* between EV subsidies and Quebec's cap-and-trade system, it becomes clear that the potential for EV subsidies to play a major role in driving emissions reductions is quite limited.

3.1 Micro-Level Analysis: Lifecycle Emissions

Suppose an individual driver replaces her existing ICE vehicle with a newly purchased electric vehicle. How much does this action reduce her carbon footprint? The answer is not so simple. The environmental performance of an EV depends on several factors, including: displaced fuel consumption with regular use; distance driven by the average consumer; emissions associated with the electricity used to recharge the battery; and the emissions associated with the manufacturing of the EV itself.

GHG emissions are generated from the *production* and the *use* of both ICE vehicles and EVs. The emissions associated with the production of an EV are higher (roughly double) than for an ICEV, due to emissions-intensive components such as the battery and electric motor. So, at the time of purchase, an EV actually has a larger negative environmental footprint than does an ICEV.[30] In contrast, ICEVs have greater emissions than EVs through regular use -- for the simple reason that ICEVs are powered with fossil fuels whereas EVs are powered with electricity, which is typically (but not always) less emitting. In Quebec, with hydroelectricity having extremely low carbon emissions, most of the emissions from EVs come from the production process.

Since EVs generate more emissions from their production, but less emissions from their regular operations, it follows that, *when examined over their lifecycle,* an environmental "payoff" from replacing an ICEV with an EV exists only if the latter is driven for several years. In Quebec, if either vehicle would be driven for about 150,000 km (an average for ten years of driving), the lifecycle emissions from the EV would be about 65% less than from the ICEV, as shown in Figure 2, with the solid horizontal line showing the EV emissions and the rising dotted line showing ICEV emissions.[31]

[30] All vehicles experience CO2 and other GHG emissions throughout their lifecycle that is usually presented in three stages: manufacturing, operation, and end-of-life

[31] Centre international de référence sur le cycle de vie des produits, procédés et services. "Rapport Technique: Analyse du cycle de vie comparative des impacts environnementaux potentiels du véhicule électrique et du véhicule conventionnel dans un contexte d'utilisation québécois". Avril 2016. Consulté à l'adresse suivante: https://www.hydroquebec.com/data/developpement-durable/pdf/analyse-comparaison-vehicule-electrique-vehicule-conventionnel.pdf

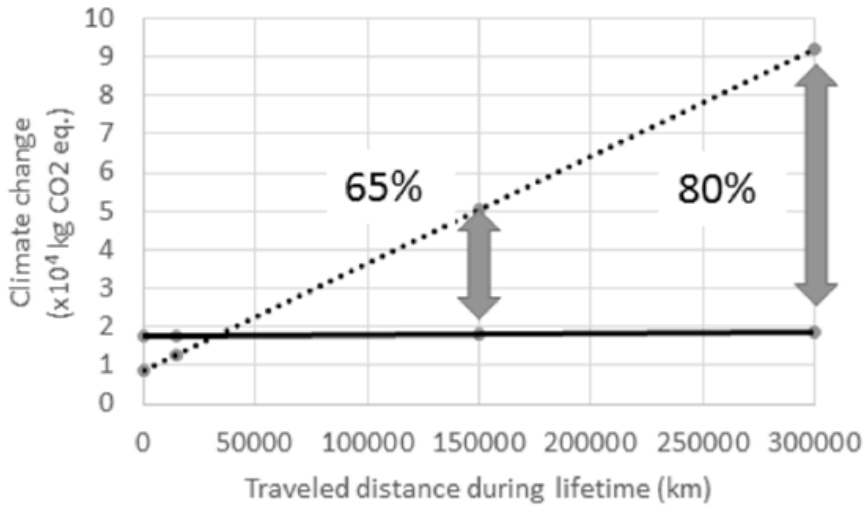

Figure 2: Lifetime GHG Emissions of EVs and ICEVs in Quebec

In Quebec, with its clean hydro power, EVs do reduce GHG emissions over the life of the vehicle -- as long as the vehicle is driven more than about 40,000 km. If the vehicle is driven for 100,000 km, its lifecycle emissions are roughly one-half that from an ICE vehicle; for a distance of 175,000 km, its lifecycle emissions are roughly one-third that from an ICE vehicle. This requirement that vehicles be driven for many years limits the ability of EVs to be an easy way to reduce GHG emissions, especially in a province where winter driving conditions and vehicle corrosion place natural limits on the life of any kind of vehicle.

Considering the limited potential for reducing emissions through greater EV adoption, the uptake of EVs in Quebec must increase hugely in order to make even a small contribution toward achieving the province's overall GHG targets. Even if Québec reaches its target of having 1 million EVs on the road by 2030, which is well above the current trajectory and over ten times the size of the current EV fleet, this would reduce emissions by only 3.6% -- when Quebec is aiming to reduce its overall emissions by 37.5%.[32] This is the sense in which it should be understood that EVs have a limited ability to be an effective weapon in the fight against climate change. In other words, EVs should not be considered as the primary or even an important way for Quebec to reduce its carbon footprint.

The environmental footprint of EVs will evolve as research and development takes place in the industry. Improved battery capacity, charging speed, and manufacturing processes each have the potential to further lessen their environmental footprint. On one hand, it is anticipated that lifecycle GHG emissions could decrease by 14% with improved battery manufacturing

[32] Germain Belzile and Mike Milke, «Les subventions aux véhicules électriques sont-elles efficientes?», Montreal Economic Institute, June 2017. Retrieved from : https://www.iedm.org/sites/default/files/web/pub_files/note0417_fr.pdf

processes.[33] On the other hand, as consumers demand ever-larger battery capacity, the relative benefits of EVs as compared with ICEVs could *decline* -- as batteries become heavier, require more raw materials, and have a larger environmental footprint. As volumes and ranges increase, an appropriate battery value chain is needed to ensure EVs can further contribute to sustainability. In summary, the net impact of future innovation on EVs' lifecycle environmental footprint is uncertain.

3.2 Macro-Level Analysis: Interaction with the Cap-and-Trade System

The previous discussion related to whether the replacement of an individual ICE vehicle with an EV leads to a reduction in an individual driver's carbon footprint. Even if such a reduction occurs, however, it *does not follow* that this will result in a reduction in Quebec's overall GHG emissions. The reason -- and it is certainly counter-intuitive -- relates to how the adoption of one more EV interacts with Quebec's existing cap-and-trade system.

Quebec's existing cap-and-trade system places a limit (or "cap") on the total GHG emissions covered by the policy. The total quantity of allowable emissions decreases each year, ensuring the province gradually decreases its carbon footprint. Emission allowances can be bought and sold at a "carbon price", which is free to vary over time. Potential GHG emitters must either reduce their emissions (and thus avoid paying the carbon price) or purchase allowances to acquire the right to emit GHGs. That Quebec's carbon price is positive -- currently about $22 per tonne -- reflects the fact that there is a "demand" from emitters to purchase these allowances. In other words, the scarcity of the emission allowances is what results in their price being well above zero.

In such a system, total emissions within the system is determined by the cap. Any "large" emissions reduction in one part of the system will be offset by "smaller" emissions reductions in another part of the system. For example, suppose the overall cap declines by 2% in a given year. If emissions in one covered sector decline by 5% in that same year, emissions reductions will be smaller in some other sectors (or emissions might even rise) in order to be consistent with the cap.

This likely sounds abstract; what is the tangible implication relevant to the adoption of EVs in Quebec? Note that Quebec's cap-and-trade system applies to the transportation sector, including the emissions generated by light vehicles. The adoption of one extra EV by a Quebecer may help to reduce GHG emissions from the transportation sector, but *it will not lead to extra emissions reductions in the overall cap-and-trade system*. As long as the overall cap is unaffected by the extra EV adoption, and as long as the carbon price remains positive, any emissions reduction from transportation will be offset by more emissions elsewhere, thus keeping overall emissions equal to the cap.

[33] Nicholas Lutsey, Dale Hall, "Effects of Battery Manufacturing on Electric Vehicle Life-cycle Greenhouse Gas Emissions," The International Council On Clean Transportation. February 2019. Retrieved from: https://theicct.org/sites/default/files/publications/EV-life-cycle-GHG_ICCT-Briefing_09022018_vF.pdf

How does this "offsetting" occur for businesses and households? Since gasoline distributors are covered by Quebec's cap-and-trade system, any extra adoption of an EV in the province will result in a decrease in the demand for gasoline. This reduces the gasoline distributors' demand for emissions allowances, and results in a small decline in the carbon price. As the carbon price declines, other potential emitters within the system -- in heavy industry, for example -- increase their purchase of allowances and thus increase their emissions. The reduced emissions in transportation are thus offset by more emissions elsewhere. This is not a "bug" in a cap-and-trade system; on the contrary, it reveals how a well-functioning cap-and-trade system operates.

What is the upshot? Even if Quebec's EV subsidies succeed in convincing consumers to replace their ICE vehicles with EVs, and even if each new EV leads to lower emissions than the vehicle it replaced, the province's *overall* GHG emissions will *not* be impacted. As long as the cap in the system is still "binding" (which is true if the carbon price is positive), then overall emissions reductions will be determined by the cap, and not by any other policy.

The same analysis holds for any policy which applies to GHG emissions already covered by the cap-and-trade. Any new policy would not reduce overall emissions but instead would simply displace emissions to other parts of the economy. In that sense, subsidizing EVs within a cap-and-trade system fails to decrease overall emissions.[34]

Higher EV uptake could, however, make it easier to increase the stringency of Quebec's cap-and-trade system, thus leading to greater emissions reductions. A significant increase in the provincial fleet of EVs could allow the government to lower the cap more aggressively. As such, the government could legislate to lower the cap faster than anticipated, thus reducing the number of allowances available for auction. In a context where Quebec has failed to reach its 2020 targets and will be challenged to meet its 2030 GHG emissions reduction ambitions, higher EV uptake could help to enable a more aggressive and decisive climate policy.

3.3 The Difficult Economics of Subsidies

The preceding analysis explains why a greater adoption of EVs is unlikely to lead to the expected reductions in Quebec's GHG emissions. Public policies designed to encourage EV adoption -- such as EV subsidies -- may therefore be inappropriate. And even if the main benefit of EV subsidies is that they assist the government in developing a more stringent climate plan for the province, there are serious problems with using subsidies as an encouragement. Some problems apply to most or all subsidies, which we address here. We then turn to examine specific problems with Quebec's EV subsidies.

[34] The same is *not* true in a province with a carbon tax, such as British Columbia. With a carbon tax, any new policy such as EV subsidies has the potential to reduce overall emissions for the simple reason that a carbon tax has no equivalent to the "cap" in a cap-and-trade system. With a carbon tax, EV subsidies reduce total emissions but leave the carbon price unaffected. With a cap-and-trade system, EV subsidies reduce the carbon price but leave total emissions unaffected.

Depending on their stringency and design, problems with subsidies often arise from their: ineffectiveness at changing behaviour; their relatively high fiscal and economic costs; and their undesirable redistributive effects.

First, depending on their stringency, *subsidies have varying degrees of effectiveness* in terms of incentivizing the sought-after behaviour. Evaluating a subsidy's effectiveness requires a careful assessment of their impact on consumption patterns. For example, if the amount of the subsidy is too low, it might not be sufficient to convince people to change their behaviour. On the other hand, the government will be wasting scarce public funds if the amount of the subsidy is higher than needed to induce the intended behavioural change.

Second, *subsidies are costly to the government and to the economy.* Any government spending involves a fiscal cost. Governments have limited access to financial resources and must allocate them carefully. Any dollar spent on a subsidy cannot be spent elsewhere, and thus the government must assess the relevant "opportunity cost". Is a dollar spent on subsidizing the purchase of EVs a better use of funds than spending on education or health care or infrastructure?

Subsidies also have a broader economic cost. The generation of tax revenue for the government requires increasing some tax rate, and this imposes a cost on the private sector of *more* than the amount of revenue raised. Economists call this the "excess burden" of a tax. Raising taxes to pay for subsidies imposes a cost on the economy because most taxes are "distortionary", especially corporate or personal income taxes. Increases in such tax rates usually lead to reductions in investment, employment and long-run economic growth.[35]

Third, *subsidies have distributive implications.* Using public funds raised through general taxation to support specific groups reallocates society's resources, and thus alters the distribution of income. For example, using public funds to provide subsidies for the production of low-income housing is likely to help low-income families more than high-income ones. In this case, the subsidy is almost certainly "progressive", and will be supported by a wide segment of society. In contrast, using public funds to provide subsidies for the purchases of products used mainly by higher-income families is likely to be "regressive" and, once this is widely understood by the public, is unlikely to generate widespread support. As we will see below, Quebec's EV subsidies suffer from this weakness.

3.4 The High Cost of EV Subsidies in Quebec

The objective of using taxpayers' money to subsidize EVs is to reduce the price differential between the two types of vehicles and make EVs more attractive. Considering the limited environmental impact of EVs, is the use of public funds to subsidize their purchase the best way to spend scarce public resources?

[35] Dahlby, B. (2008). *The marginal cost of public funds: Theory and applications.* MIT Press, Cambridge (Massachusetts). En ligne : https:// mitpress-request.mit.edu/sites/default/files/titles/content/9780262042505_sch_0001.pdf

The following analysis evaluates the *Roulez vert* subsidy along the three following criteria:

- The effectiveness of subsidies at encouraging the purchase of EVs;
- The cost-effectiveness of subsidies in terms of reducing GHG emissions;
- The redistributive impact of the subsidies.

3.4.1 ARE SUBSIDIES SUCCESSFUL IN DRIVING EV ADOPTION?

The introduction of the Quebec subsidy in 2012 did not seem to trigger an immediate increase in EV purchases. As shown in Figure 3, a gradual increase in EV purchases can be observed in the following years, which could have been driven by a combination of lower retail prices, increased EV information campaigns, increased awareness of the subsidy and more available models on the market. The sharp increase in 2019 may be explained by the introduction of the $5,000 federal subsidy, which permitted the maximum combined subsidy (federal plus provincial) available to Quebec consumers to rise to $13,000.

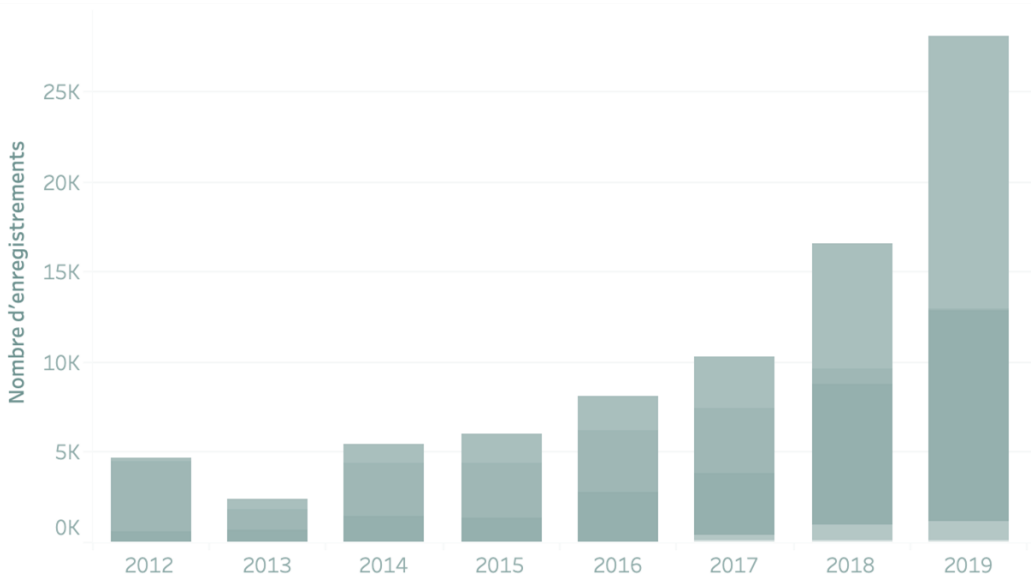

Figure 3: Number of registered EVs in the province of Québec from 2012 to 2019[36]

To understand why EV subsidies may drive only a modest amount of EV adoption on average, it is worth thinking about two different groups of consumers -- those that required the subsidy in order to purchase the EV and those that would have purchased it even without the subsidy. In the new Abacus survey of Quebec consumers, 45% of respondents said they would "certainly not" or "probably not" have purchased the EV without the subsidy. For these individuals, the policy is actually changing their behaviour in the intended manner. But the same survey finds that 54% of respondents would "certainly" or "probably" have bought the EV even if there were no

[36] Association des véhicules électriques du Québec, "Statistiques SAAQ-AVÉQ, sur l'électromobilité au Québec en date du 31 mars 2020 [Infographie]. Consulté à l'adresse suivante : https://www.aveq.ca/actualiteacutes/statistiques-saaq-aveq-sur-lelectromobilite-au-quebec-en-date-du-31-mars-2020-infographie

subsidy available. For these consumers, the policy is a pure gift from taxpayers to the purchaser but has no impact in terms of changing their behaviour.[37]

That there are two groups of consumers with such different purchasing behaviour explains why the *average* adoption of EVs may only respond modestly to the subsidy program. For roughly half of the consumers, the subsidies make no difference whatsoever! This helps to explain why in 2019, when Quebec consumers had a total of $13,000 available as a subsidy, EVs made up only 7% of new vehicles purchased.

That there are many consumers for whom the subsidy does not alter purchasing behaviour also explains why the EV subsidy program is so expensive for what is achieved. If the Quebec program pays an $8000 subsidy to two consumers, one from each group, but only one of them actually purchases the EV *because of the subsidy*, then the real fiscal cost of increasing the EV fleet by one car is actually $16,000.

3.4.2 THE COST-EFFECTIVENESS OF EV SUBSIDIES

Policymakers naturally care about the fiscal cost of their policies, as governments have limited financial resources at their disposal. Québec's most recent budget allocates $434 million toward these subsidies for the two fiscal years of 2019-20 and 2020-21. As estimated by a recent report by the Montreal Economic Institute, it would cost the government a total of $8.6 billion to achieve a Quebec EV fleet size of 1 million cars, assuming the current rate of EV uptake and an average subsidy of $4,000 per car.[38] [39]

A broader and ultimately more useful measure of the cost of any climate policy is its *cost-effectiveness* -- defined to be the total fiscal and economic cost of reducing one additional tonne of GHG emissions under the policy.

In general, a policy that provides *flexibility* in terms of how households and businesses can reduce their GHG emissions has a lower cost to the economy than a more prescriptive one, as economic actors can choose the least costly actions. A carbon price -- as in Quebec's cap-and-trade system -- is very flexible because it is not prescriptive in terms of how businesses or households choose to reduce their emissions. In contrast, subsidies for specific products tend to be *inflexible* since they incentivize particular types of behaviour, such as buying an EV.

To evaluate the cost-effectiveness of Québec's EV subsidy program, we can divide the number of tonnes of GHG emissions reduced (attributed to the EV subsidy) by the total fiscal and economic

[37] These data are consistent with those from a recent study by Xavier Mercier, Paul Lanoie, and Justin Leroux: "Costs and Benefits of the 'Quebec Purchase/Lease Rebate Program for Cleaner Vehicles'," HEC Montréal, September 2014, p. 11.
[38] These numbers assume that none of the cars purchased between now and then would need replacing.
[39] Germain Belzile, Mark Milke, "Are Electric Vehicle Subsidies Efficient?," Montreal Economic Institute, June 2017. Retrieved from: https://www.iedm.org/71215-are-electric-vehicle-subsidies-efficient/

cost of the subsidy. It is then useful to compare this cost to the costs associated with other climate policies.

Modelling done by Canada's Ecofiscal Commission estimates total emissions reductions attributable to Québec's EV subsidy to be 3 Mt by 2030 if the province's EV targets are met. The resulting estimate of the cost per tonne of emissions reduced is $395 -- almost 18 times the current carbon price under Quebec's cap-and-trade system.[40] If the cap-and-trade system is able to reduce GHG emissions at a cost of approximately $22 per tonne, it is difficult to see the rationale for using EV subsidies that can only reduce emissions at a far higher cost.

The actual costs associated with Quebec's EV subsidies are likely *even higher* than these estimates, since the policy overlap has not been considered. As discussed earlier in this report, any overlap between the EV policy and the cap-and-trade system leads to redundancy, decreased effectiveness in reducing GHGs and therefore an even higher estimate of the cost per tonne of emissions reduced.

In addition to the overlap between the EV subsidy and the cap-and-trade system, the subsidy also overlaps with the province's ZEV mandate, as they substitute for one another in trying to directly incentivize the number of EVs on the road. This adds further redundancy into the policy package and further raises the overall cost of reducing GHG emissions.

Finally, the EV subsidy overlaps with the federal fuel efficiency standards. Since EVs decrease average emissions, manufacturers have less incentive to make more fuel-efficient traditional vehicles, which ends up cancelling out the net additional GHG reduction potential from the EV subsidy.

3.4.3 THE DISTRIBUTIVE IMPACT OF EV SUBSIDIES

Subsidies can have considerable redistributive impacts as they reallocate general tax revenues toward particular groups in society. In the case of EV subsidies, a significant amount of public funds disproportionately benefits wealthier households.[41]

Three specific observations are relevant on this point. First, a recent survey by the *Association des véhicules électriques du Québec* suggests that 87% of EV owners are male, with an average income of between $70,000 and $80,000. In contrast, the average income of Quebecers is only $49,312.[42]

[40] An alternative analysis by the Montreal Economic Institute yields a cost per tonne of GHG emission at $288. This amount does not include the cost of free-ridership and of the policy overlap. Regardless, this amount is still 16 times more than the carbon tax and 29 times more than the province's cap-and-trade.From: Germain Belzile, "Are Electric Vehicle Subsidies Efficient?,"

[41] Canada's Ecofiscal Commission, "Supporting Carbon Pricing: How to Identify Policies That Genuinely Complement an Economy-Wide Carbon Price," June 2017.

[42] Statistics Canada, "Average weekly earnings (including overtime) for all employees - Seasonally adjusted". 2019. Retrieved from: https://www150.statcan.gc.ca/n1/daily-quotidien/190327/t001c-eng.htm

Second, EVs are often purchased as second cars: 51% of EV owners also own an ICE vehicle, suggesting most EV owners are wealthy enough to own multiple vehicles.[43]

Third, note that EVs tend to have considerably higher prices than ICEVs. In Québec, the average Manufacturer Suggested Retail Price (MRSP) for an EV is $68,377[44] but for an ICEV is only $34,060.[45] Since EVs typically cost more than traditional vehicles, and since lower-income families tend to purchase lower-priced vehicles -- if they can afford to purchase a vehicle at all -- we can conclude that the EV subsidy program tends to favour higher-income families.[46]

These observations all point in the same direction -- that EV subsidies are "regressive", meaning that they disproportionately redistribute tax revenues toward higher-income households. This regressiveness may decline as the price threshold for the subsidies falls from $75,000 to $60,000, but as long as EVs remain a vehicle purchased mostly by higher-income families, observers can legitimately question the appropriateness of such a regressive policy.

[43] AVEQ members do not represent the entirety of EV owners. Members are EV owners who decide they want a membership to support the mission of the Association. There are two membership option: the "Friend Member", which is free, and the "Gold Member", which costs 49$/year and offers additional advantages.
[44] This number is based on data made available by Plug' n' Drive Québec. An average of prices for available models was calculated. Retrieved from: https://www.plugndrive.ca/electric-cars-available-in-canada/
[45] Michel Deslauriers, "Study Shows Average New-Car Price in Canada is $40,490," Motor Illustrated, December 2019. Retrieved from: https://motorillustrated.com/study-shows-average-new-car-price-in-canada-is-40490/40716/
[46] Canada's Ecofiscal Commission, "Bridging the Gap: Real Options for Meeting Canada's 2020 GHG Target," November 2019. Retrieved from: https://ecofiscal.ca/wp-content/uploads/2019/11/Ecofiscal-Commission-Bridging-the-Gap-November-27-2019-FINAL.pdf

SECTION 4

ALTERNATIVE POLICIES TO SUPPORT THE ADOPTION OF ELECTRIC VEHICLES

This section explains our recommendation to phase out Quebec's EV subsidies. It also identifies some non-climate-related reasons why the government might still want to support EV adoption, and so provides some alternative policies to more cost-effectively increase the uptake of electric vehicles.

4.1 Recommendation #1: Phase Out EV Subsidies

We recommend phasing out the existing EV subsidies, as they have only a modest impact on EV uptake, have little or no impact on reducing additional emissions under Quebec's existing cap-and-trade system, and are costly for the government and the economy. A phase out is probably preferable to an abrupt termination of the policy as it would minimize public backlash by maintaining predictability.

We recommend that Quebec's EV subsidies decrease by $2,000 each year, to be completely phased out by 2025. This would "free up" over $200 million annually, funds that could be spent on more effective climate policies.

The annual amount of reduction ($2,000) and the sunset year of 2025 are intended to allow for a clear, predictable, and politically acceptable transition away from subsidies.

4.1.1 JUSTIFICATION FOR THE RECOMMENDATION

First, EV subsidies have limited impact on EV uptake, as the ZEV mandate and fuel efficiency standards already provide incentives to spur the EV market. Quebec's $8,000 subsidy had limited impact on EV purchasing decisions, indicating that many people who purchased the vehicle with a subsidy would have done so without the subsidy. According to a new survey by Abacus Data from August 2020 (commissioned specifically for this report), 56% of respondents acknowledged that they would have certainly or probably purchased their EV even if the subsidy had not been available. (See Appendix 6 for more details about this survey.)

Second, EV subsidies do not reduce additional emissions in a cap-and-trade system, because the emissions reduced by EVs are replaced by the production of emissions by another source covered by the system.

Third, EV prices are expected to reach parity with ICE vehicles by the mid-2020s, as suggested by discussions with industry, and most forecasts and reports.[47] Subsidies to bridge the gap between more expensive EVs and cheaper ICE vehicles can therefore be eliminated gradually over the next few years. Based on results from the Abacus survey, the EV market is expected to have a bright future -- 78% of respondents believe that the popularity of EVs will increase over the next five years.

Fourth, EV subsidies are not a cost-effective way to reduce emissions. To be relatively cost-effective, emissions-reduction policies, measured in dollars per tonne, should not vastly exceed the market price of the cap-and-trade system, currently at $22.50 per tonne. At $395 per tonne, EV subsidies under a binding cap-and-trade system are an extraordinarily costly way to reduce emissions.

4.1.2 LESSONS FROM OTHER JURISDICTIONS

This recommendation to phase out EV subsidies follows the pattern in many countries that are leaders in EV adoption. Norway has phased out subsidies, will eliminate tax exemptions after 2021, and plans to phase out the remainder of incentives in the short term. China reduced EV purchase subsidies by approximately half in 2019 – part of a gradual phase out of direct incentives set out in 2016. The United States Federal Tax Credit Programme has run out for EV makers Tesla and General Motors, as each have met their eligible sales cap under which they can receive subsidies.

Around the globe, there is a common understanding that government support for EVs must be transitional only, as these policies are too costly to maintain, and their effectiveness has fallen over time. Indeed, for the first time, a decrease in government spending for EV purchase incentives was observed in 2019, while both consumer spending and total expenditure on EVs continued to increase. Shifts to a variety of regulatory measures are likely to become a main driver of EV adoption, setting clear goals and a long-term vision for the industry.

4.1.3 CONSUMERS' RESPONSE TO SUDDEN SCARCITY?

One final word on EV subsidies: If the Quebec government follows this recommendation and announces a phase-out of the EV subsidy, there is likely to be a sudden and noticeable increase in the number of EV purchases. This should be interpreted as consumers' desire to take advantage of a generous policy they know will soon disappear -- not as evidence that EV subsidies are highly effective during normal times. Using this kind of scarcity to increase EV purchases was used successfully in California when the government limited benefits to the first 85,000 buyers to accelerate purchasing.

[47] Colin McKerracher et al., "Electric Vehicle Outlook 2020," BloombergNEF. Retrieved from: https://about.bnef.com/electric-vehicle-outlook/

4.2 Some Non-Climate Benefits of Electric Vehicles

Though subsidizing EV purchases with public funds is a very costly way to reduce GHG emissions, EVs themselves have several additional, non-climate-related benefits that may justify a more modest and different kind of public support. The Quebec government may want to encourage the adoption of EVs as a means of improving health outcomes, increasing energy security, promoting greater road safety, or even -- and this is a little speculative -- of enabling the adoption of more aggressive climate action.

Health Outcomes

Contrary to ICEs, EVs produce no air particulates, such as NOx and PM2.5, which are released through tailpipes and are harmful to human health. It is estimated that the health costs saved during the life of an EV is $1,686 due to decreased hospitalization from cardiovascular and respiratory issues caused by air particulates released by ICE vehicles.[48] While a benefit of under $1,700 that occurs over several years certainly does not justify an $8,000 subsidy from taxpayers, it does support the case for more modest policies designed to encourage the use of EVs.

Energy Security

Quebec imports over 150,000 barrels of oil per day from foreign countries, a total of $5.52 billion in 2019.[49] Instead of relying on foreign oil imports, widespread adoption of EVs would allow Quebec drivers to be powered by their "own" provincially generated hydropower. To the extent that imports of foreign oil are less secure, a greater reliance on Quebec's hydro power can improve the province's overall energy security.

Road Safety

EVs have very heavy batteries, which are placed low in the car. This lower center of gravity makes EVs less likely to roll over in the case of a collision. Without combustible and flammable liquids in the vehicle, EVs have a lower risk of major fires or explosions. The Fatality Analysis Reporting System found that fire was related to 2.6% of fatal crashes in EVs, compared to 4.4% in ICEs.[50]

More Aggressive Climate Action?

As explained earlier, EVs do not contribute to reducing *overall* GHG emissions within the province's cap-and-trade system, even though they would contribute to reducing *transportation*

[48] Ingrid Malmgren, "Quantifying the Societal Benefits of Electric Vehicles," World Electric Vehicle Journal 8, no. 4 (2016): 986–97.Retrieved from: https://res.mdpi.com/d_attachment/wevj/wevj-08-00996/article_deploy/wevj-08-00996.pdf

[49] Canada Energy Regulator, "Market Snapshot: Imports of crude oil continue to decrease in 2018," Government of Canada, March 2019. Retrieved from: https://www.cer-rec.gc.ca/nrg/ntgrtd/mrkt/snpsht/2019/03-03mprtscrdl-eng.html

[50] Soumen Mandal, "Are Electric Vehicles Safe?," Counterpoint, November 2019. Retrieved from: https://www.counterpointresearch.com/electric-vehicles-safe/#:~:text=The%20probability%20of%20an%20EV,cases%20of%20fatal%20vehicle%20crashes.

emissions. However, a large-scale increase in Quebec's EV fleet would lead to a reduction in the province's gasoline demand and this would lead to a reduction in the province's carbon price. With a lower carbon price, the Quebec government may find itself willing to implement a more aggressive reduction of the cap, thereby leading to greater overall emissions reductions. In other words, the greater use of EVs, though not directly reducing emissions, may help to drive the government toward more climate action, helping the province to reach its emissions targets for 2030 and beyond.

4.3 Alternative Policies to Support EV Adoption

If the Quebec government chooses to continue supporting increased EV adoption, but agrees that phasing out EV subsidies is appropriate, there are alternative policies worth considering. They can be motivated by the different market failures discussed in Section 3, each of which represents a barrier to EV adoption. The political popularity of this general approach should be noted; the new survey by Abacus Data found that 84% of Quebecers are in favor of *some form of* government policies to support EV adoption.

We examine four alternative policies. Each can be designed to have a low fiscal cost to the government. In addition, because they are not based on the use of expensive subsidies, they are likely to be a more cost-effective approach for encouraging the adoption of EVs. The fours policies are:

1. Increase the stringency of the ZEV mandate;
2. Require new building construction to include charging capacity;
3. Introduce more EV/HOV lanes on existing freeways;
4. Launch an improved information campaign about EVs.

4.3.1 RECOMMENDATION #2: INCREASE THE STRINGENCY OF THE ZEV MANDATE

If the Quebec government is committed to continuing its support for EVs, we recommend that the current ZEV mandate compliance credits become more stringent by applying to a larger percentage of ZEV sales.

The ZEV mandate is the policy tool most adapted to increase EV uptake, addressing the supply issue using a market-based tool. Given the important role that the ZEV mandate has on ensuring the availability of EVs, ramping up the share of ZEV sales credits would be a strong policy signal forcing automakers to focus their innovation activities to develop, actively market, and sell more EVs in Quebec.

A more stringent mandate -- which requires more EVs to be sold into the Quebec market -- is likely to lead manufacturers to expand their existing "cross-subsidization" of different types of vehicles. A natural response to this kind of policy is for manufacturers to increase the price of ICE vehicles while reducing the price of EVs, thus helping to ensure that they succeed in satisfying the mandate. Such pricing behaviour tends toward reducing the existing price gap between the two types of vehicles, thus assisting in overall EV adoption by consumers.

The cost of compliance from adjustments in the ZEV policy falls on automakers and some part of that cost will be passed on to consumers. However, this policy does not involve any significant direct fiscal cost for the government.

4.3.2 RECOMMENDATION #3: REQUIRE CHARGING STATIONS FOR NEW BUILDINGS

If the Quebec government is committed to continuing its support for EVs, we recommend that all new commercial and residential buildings be required to have 20% of the associated parking spaces equipped with EV charging capacity, while the remaining 80% of spaces must support the installation of charging stations in the future.

Québec differentiates itself from other jurisdictions by the number of available public charging points and has one of the best charging infrastructure systems in the world. Thanks to Hydro-Québec, the province is now equipped with over 5200 240V and over 400 480V charging stations (in addition to 162 Tesla Superchargers).[51] [52] (For more details on Québec's charging infrastructure see Appendix 4.)

However, the charging infrastructure remains inadequate in commercial and multi-unit residential buildings. Older buildings often do not have the necessary back-end infrastructure to allow for the installation of private charging stations.

For single-family detached, semi-detached homes and townhouses with garages (attached and detached), new builds should be built to be "EV ready", having the necessary back-end infrastructure. Buildings that have already received an approved building permit would be exempt from this regulation. Older buildings that service 100 people or more per day would be required to add charging stations by 2026.

[51] 240V charging stations provide an autonomy of 40km per hour charging. 400V charging stations provide an autonomy of 250km per hour charging. Tesla Superchargers provide an autonomy of 540km per hour charging.
[52] Association des véhicules électriques du Québec, "Statistiques SAAQ-AVÉQ, sur l'électromobilité au Québec en date du 31 mars 2020 [Infographie]. Retrieved from : https://www.aveq.ca/actualiteacutes/statistiques-saaq-aveq-sur-lelectromobilite-au-quebec-en-date-du-31-mars-2020-infographie

Requiring new commercial construction to include charging stations would alleviate concerns about range anxiety -- a concern which still represents a significant barrier to EV adoption for more than 80% of Quebecers, according to the new survey by Abacus Data. This would allow urbanites without garages to have access to charging infrastructure and would mitigate range anxiety for suburbanites who may need to charge their vehicle while in the city.[53] Such a policy has been successfully adopted in both British Columbia and Ontario (see box below).[54] Increased access to charging infrastructure has also been identified by 87% of Quebecers as a key element in EV adoption.[55]

Adding charging stations to new infrastructure has a one-time cost of approximately $5,000 to $6,000 per station in commercial areas and $1,000 to $1,200 in single-family residential structures. This is not a major cost burden for large businesses and no financial incentive from the government would be required. It is significantly more expensive (approximately $20,000) for existing buildings to add EV charging capacity, as the cost to retrofit the electrical changes is much higher after construction has been completed. It is therefore more economic for developers to be required to implement charging capacity in new buildings, than for the government to implement a policy several years from now that requires old buildings to be retrofitted.

Case Study: Ontario and British Columbia

Both Ontario and British Columbia have introduced regulations requiring new buildings to be "EV ready". Ontario's 2018 regulation requires that 20% of parking spaces be equipped with EV charging capacity and the remaining 80% be designed in such a way that enables future charging installations.[56] In British Columbia, bylaws have been introduced at the municipal level and have been adopted in most cities and districts. In Vancouver specifically, 100% of parking stalls must be EV-ready in multi-unit residential buildings, 10% in commercial buildings, and 1 in single-family homes with garages.[57] Given that the density of condominiums in Vancouver is much higher than in Montreal, we recommend a requirement of EV-readiness in both commercial and residential buildings. Both Ontario and British Columbia have similar EV uptake levels as Quebec, and similar proportions of charging stations would therefore be appropriate.

[53] Hauke Engel et al., "Charging ahead: Electric-vehicle infrastructure demand," Mckinsey & Company, August 2018. Retrieved from: https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/charging-ahead-electric-vehicle-infrastructure-demand#

[54] EVdirect, "2018 Ontario's New EVSE Regulations," EVdirect. Retrieved from: https://evdirect.ca/ontario-new-evse-regulations/#1

[55] Abacus Data, "Quebec EV Survey," Abacus Data, August 2020.

[56] EVdirect, "2018 Ontario's New EVSE Regulations,"

[57] PluginBC, "Electric Vehicle Policies," PluginBC. Retrieved from: https://pluginbc.ca/policy/#:~:text=For%20new%20buildings%20current%20bylaw,in%20multi%2Dunit%20residential%20buildings

4.3.3 RECOMMENDATION #4: EXTEND HOV/EV LANES

If the Quebec government is committed to continuing its support for EVs, we recommend that HOV/EV lanes should be extended in and out of major cities, given that EVs are eligible to use HOV lanes.

There are approximately 15 kilometers of HOV lanes available for EVs near Montreal and Quebec City, which is inadequate to deliver a strong mobility benefit to EV drivers. That is, EV drivers in these two cities do not experience a daily, tangible benefit in terms of enhanced mobility; they still spend significant time in traffic. Since EV drivers are permitted to drive in HOV lanes, their mobility would be enhanced and the appeal of driving an EV would rise considerably. Particularly in and out of cities where maximum congestion occurs, we recommend the addition of EV/HOV lanes as a means of encouraging EV adoption. The new survey by Abacus Data finds that 72% of Quebecers indicate that increased access to HOV lanes would help to convince them to purchase an EV.[58] This policy was implemented in California with considerable success (see box below).

This policy has a low fiscal cost, as costs are primarily related to new signage rather than the construction of new road infrastructure.

Case Study: California

As in Quebec, California allows EV drivers are eligible to use HOV lanes. Californian drivers indicate their eligibility by placing a sticker on their EV. Research from the UCLA Luskin Center for Innovation found access to HOV lanes significantly impacted EV sales, concluding that the value of time saving was responsible for 40% of EV sales.[59] While California also uses EV subsidies, they are one-third the value of Quebec's, and California's EV fleet is almost 8% of total vehicles (compared to less than 2% in Quebec).[60] California limited the number of vehicles eligible to use the lanes to avoid congestion in EV/HOV lanes, so results in Quebec may differ slightly.

[58] Abacus Data, "Quebec EV Survey," Abacus Data, August 2020.
[59] Dan Weikel, "Law expanding HOV access to plug-in cars drives higher sales, UCLA study says," LA Times, November 2015. Retrieved from: https://www.latimes.com/science/la-me-1111-california-commute-20151111-story.html
[60] Banque de données statistiques officielles du Québec, "Nombre de véhicules en circulation selon le type d'utilisation et le type de véhicule, Québec, régions administratives et municipalité de résidence du propriétaire du véhicule" Quebec Government. Retrieved from: https://bdso.gouv.qc.ca/pls/ken/ken213_afich_tabl.page_tabl?p_iden_tran=REPERBYT0JI51-1700850309064bOf&p_lang=2&p_m_o=SAAQ&p_id_ss_domn=718&p_id_raprt=3628#tri_tertr=00&tri_mun=aaaaa

4.3.4 RECOMMENDATION #5: SCALE-UP THE EXISTING INFORMATION CAMPAIGN

If the Quebec government is committed to continuing its support for EVs, we recommend the government scale up its existing *Roulons électrique* information campaign and extend it until at least 2025.

Insufficient consumer knowledge and incorrect perceptions about EVs are important market failures that create barriers to the adoption of EVs. To address this, and in an attempt to influence consumer behaviour, the Quebec government launched the *Roulons électrique* triennial information campaign in 2019, a joint initiative between *Transition Énergétique Québec* and *Équiterre*.[61]

The content disseminated by the *Roulons électrique* campaign appears comprehensive. It provides citizens with interesting and useful tools such as webinars, tests and short video clips, informing consumers about EVs. However, the campaign was apparently not widely circulated, which limited its impact. Results from the new Abacus survey showed significant misconceptions and factual errors from respondents regarding EVs, particularly with regard to location and convenience of charging stations, range of a vehicle on one charge, and vehicle performance in winter. We recommend the campaign focuses on these key elements, as the survey also indicated that they were all key factors in a consumer's purchasing decision; therefore, providing better information may increase EV uptake. The government should scale up the *Roulons électrique* campaign to help Quebecers acquire the necessary information to make more informed vehicle purchasing decisions. The government should consider television, radio, poster and social media advertising.

The government should extend the campaign at least until 2025, to accompany the subsidy phase-out. It would be advisable for the ad campaign to ramp up as the EV subsidies ramp down. The government should also consider strategies to draw attention to EV infrastructure. For example, adding a sticker that informs the presence of an EV charging station on highway exit signs, next to stickers informing drivers about the next gas station, hotel and restaurants.

The total cost of a scaled-up information campaign would naturally depend on its scope and duration, and also on which media are utilized -- television, radio, social media, billboards, direct mailings to residents, or other. Depending on the details of the campaign, the cost could be as little as a few million dollars per year, or with much greater ambition could easily rise to be well above that. For comparison purposes, the Quebec government expects $15 million worth of advertising expenses between April and December 2020 for its COVID-19 information campaign. In New Zealand, a country with roughly half of Quebec's population, the government invested in a five-year EV information campaign at a cost of $1 million per year.

[61] Roulons électrique, "About" Transition énergétique Québec. Retrieved from: https://www.roulonselectrique.ca/fr/a-propos/

SECTION 5

USING THE GREEN FUND MORE EFFICIENTLY

As explained earlier, spending public money to increase EV uptake will not in itself help to reduce Quebec's GHG emissions. Within the existing cap-and-trade system, additional policies that generate reduced emissions in one part of the economy, such as the transportation sector, will serve only to displace emissions to a different part of the economy, such as heavy industry.

5.1 A Desire for More Aggressive Climate Action?

Quebec's current cap-and-trade system is already contributing to reducing GHG emissions in the province. If the government wishes to take *more aggressive* climate action, and still prefers low-cost policies, it should make the cap-and-trade system more stringent. This can be accomplished by:

(a) Reducing the "cap" and the associated number of allowances;
(b) Increasing the scope of the system to cover a greater portion of the economy.

The first change would likely increase the province's carbon price. The second change need not alter the price, but a larger share of the economy would be subject to the price incentives. In both cases, households and businesses would face the economic incentive to change their behaviour in ways that reduce GHG emissions.[62] [63]

In pursuit of more aggressive climate action, the government should increase the stringency of its cap-and-trade system -- either by reducing the cap or by broadening the coverage.

It is worth emphasizing the importance of this point. In those parts of the Quebec economy that are currently covered by the cap-and-trade system, emissions will fall more aggressively *only if* the cap is tightened. The cap is the primary tool for reducing emissions. Only in the uncovered part of the economy -- which has roughly 15% of provincial emissions -- would it make sense to adopt other climate policies, although even there the use of the carbon price from the cap-and-trade system would lead to *lower-cost* emissions reductions. In other words, broadening the coverage of the cap-and-trade system to those sectors would offer the lowest-cost way of reducing their emissions. The box below reminds the reader of the benefits of using carbon pricing as the primary climate policy in Quebec.

[62] Since Quebec's cap-and-trade system is linked with California's, a decision to tighten the cap would naturally be coordinated with California. The decision to broaden coverage within Quebec could be made unilaterally.
[63] Chois Carmody, "A Guide to Emissions Trading Under the Western Climate Initiative," Centre for International Governance Innovation, 2019. Retrieved from: https://www.cigionline.org/sites/default/files/documents/Guide%20to%20Emissions_Carmody_Special%20Report_lowres_0.pdf

The Benefits of Carbon Pricing in Quebec

Carbon pricing is the most cost-effective means of reducing emissions, as a market-based system is more efficient than other policies, such as inflexible regulations. It sets a clear, mandatory, and enforceable limit on GHG emissions, but allows the market to determine the most cost-effective way to reach this limit.

Carbon pricing with a cap-and-trade system creates a market for pollution reduction, creating a financial incentive for technology and process innovation that reduces pollution. This encourages low-emissions energy sources and technologies.

Carbon pricing currently covers most of the Quebec economy. While passenger vehicles are responsible for 21% of emissions, a carbon pricing system such as cap-and-trade allows for emissions reduction across approximately 77% of the economy, including the transportation sector. Carbon pricing allows revenue to be reinvested into the economy, spurring economic development.

Carbon pricing provides businesses and consumers with autonomy to pay the market price of carbon or to substitute towards lower emissions goods. It does not force any behaviour, but rather encourages the selection of lower-carbon products through a financial incentive.

If the government decides to phase out its existing EV subsidies, roughly $200 million annually will become available (inside the Green Fund) to finance other climate policies. If the government further decides to tighten the cap on the cap-and-trade system, it will likely lead to more revenues (to the Green Fund) generated from the regular auction of allowances.

How can such funds be reinvested in a way that genuinely addresses climate change and does so in a cost-effective manner?

We next turn to examining some alternative ways to spend money from the Green Fund. But before doing so, it is important to emphasize that the Green Fund's governance issues must be addressed, and this should happen soon. It is beyond the scope of this report to get into these governance issues, but note that the *Commissaire du développement durable* has recently been mandated to provide recommendations on how to best tackle the Green Fund's governance issues.[64] These changes must be implemented to allow for clear, efficient, transparent and accountable management of the money generated by the cap-and-trade system. (See Appendix 5 for a description of the types of projects funded by the Green Fund).

[64] Transportation and Environment Commissions, "Audition - Vérificateur général du Québec", Quebec National Assembly. January 22, 2020. Retrieved from: http://www.assnat.qc.ca/fr/video-audio/archives-parlementaires/travaux-commissions/AudioVideo-84081.html

We now examine three specific alternative uses for the Green Fund, each designed for different policy priorities. They are separate policies with different outcomes -- the government could choose to adopt one, two, or all three of the policies based on its objectives.

- *To advance Quebec's role as an innovation hub*, the Green Fund could be used to support businesses and their emissions-reduction efforts through an innovation fund that can be used to fund early and mid-stage projects that support jobs, increase private investment, and help position Quebec as an innovation leader.
- *To decrease emissions in the transportation sector,* the Green Fund could be used to invest in public transportation, enabling people to commute through lower-emitting means of transport than single-occupancy ICEs.
- *To support economic activity and post-pandemic recovery,* the Green Fund could be used to support individuals by returning money to residents in the form of a rebate, stimulating private spending and supporting people during challenging economic times.

We evaluate these policies using six criteria: economic growth, emissions reductions, cost-effectiveness, fiscal cost to the government, political favourability, and simplicity.

INNOVATION

Support businesses and their emissions-reduction efforts through an innovation fund

PUBLIC TRANSIT

Invest in public transportation, enabling people to commute with fewer emissions

CLIMATE DIVIDEND

Support individuals by returning money to residents in the form of a rebate

5.2 Option 1: Invest in Low-Emissions Technology

5.2.1 THE "VALLEY OF DEATH" FOR INNOVATORS

Innovation in clean technologies is necessary to help emitters reduce their emissions quickly and efficiently, and also for the province to achieve its GHG reduction targets. Without such innovation, it can be very costly for emitters to reduce GHGs and widespread technology adoption is often limited.

Recognizing this, Quebec and the federal government have invested significant funding in innovation and clean technology through research grants to universities. They have also placed public funds with private entities which pool the public funds together with money from private investors to invest in clean-tech projects; examples include ArcTern Ventures, Renewal Funds, and Cycle Capital Management. In addition, there are government entities such as BDC, SDTC, and Innovation Superclusters that use public funds to directly support the clean-tech sector.

These funds all target either early-stage or late-stage projects. However, most projects struggle with access to capital mid-way through project development. This problem is so severe and well-known that it has been dubbed the "valley of death" by innovators. This is a particularly significant problem for clean technology, as projects are generally high risk because they use new and unproven technologies. They are also capital-intensive, as projects involve major infrastructure -- unlike the tech sector, which has much lower costs required to prove technology.

Without government funding to get innovators through the valley of death, investments in early-stage technologies are often unable to reach commercialization, solely because they lack access to capital as they try to advance. By enabling access to capital, government funding at early stages will have a greater impact, and more technologies will be commercialized, creating jobs and strengthening the economy. Limited funding is currently available in Quebec that specifically supports clean-tech projects in surviving the trek through this valley of death.

5.2.2 RECOMMENDATION #6: ALLOCATE FUNDING TO SUPPORT CLEAN-TECH INNOVATION

We recommend the government allocate funding to mid-stage clean-tech innovation to support businesses in achieving commercialization, reducing emissions, and accelerating Quebec in becoming an innovation hub.

Funding should be allocated through a competitive process and should focus on the greatest opportunities for emissions reduction and economic development. This fund should not be focused on a specific sector, but rather should be open to all opportunities to significantly reduce emissions over the longer run. Funding allocation should secure a diversity of projects and maximize the number of technologies that will achieve commercialization, while also ensuring that each technology receives enough funding to meaningfully impact their ability to move forward with the project. We recommend that the government focus on mid-stage technologies which are vulnerable to the "valley of death" and require significant access to capital to reach commercialization.

There is no need for Quebec to create a new institution in order to implement this policy. Funding should be allocated through Investissement Quebec (IQ) (or a similar body) to ensure funding decisions remain apolitical, but still have accountability to the government. With a long history of funding successful projects and a strong governance structure, IQ is well-positioned to administer funds to innovative technologies. We recommend the government require IQ to use a GHG accounting tool to measure emissions abatement potential in order to measure the impact of these investments in technology.

IQ should be given the mandate to work with the federal government to ensure federal alignment and leverage federal programs where possible. IQ should be allowed to administer grants, loan guarantees, equity, and other funding mechanisms. Technologies that have the best potential for achieving emissions reductions, return on investment, cost-effectiveness, and a clear path to market success should be favoured.

5.2.3 EVALUATION CRITERIA

We briefly evaluate this policy proposal along the six criteria mentioned above. The Quebec government may put more weight on some criteria than others, but it is nonetheless worth mentioning them all.

Economic Growth: Supporting research and development has proven effective in several jurisdictions globally. It fosters economic development and supports Quebec in becoming an innovation hub. Funding several technologies across many sectors supports economic diversification, growing underdeveloped sectors and enabling Quebec to better weather future economic storms.

Investing in emissions-reducing technology can reduce competitiveness pressures over the long term, as it can allow firms to decrease their emissions at a lower cost. Support for technology development may also support competitiveness by helping lead Quebec businesses in bringing their technologies to international markets, supporting significant economic growth. Without the ability to scale, technologies do not reach commercialization and the Quebec economy fails to receive the benefits of emissions reduction, job creation, and economic development that comes from the widespread adoption of technology.

Emissions Reductions: Allocating funding to businesses to drive clean innovation will make it politically more feasible to tighten the emissions cap and increase Quebec's carbon price, which incentivizes businesses within the cap-and-trade system to decrease their emissions. This enables more widespread emissions reductions and encourages innovation across the Quebec economy.

Firms tend to under-invest in innovation, as they know that competitors often benefit from their innovations. By supporting innovation through public funds, the government can ensure a larger number of affordable clean technologies are made available. In the case of emissions reduction technology, this helps Quebec's transition to a lower carbon economy. Indeed, supporting clean technologies in their development will increase their adoption and thus reduce the cost of abating emissions. By making it easier for firms to adopt clean technologies, the government reduces the cost of reducing emissions, helping to maintain business competitiveness within Quebec.

Cost-Effectiveness: Research by Canada's Ecofiscal Commission indicates that investments in technology are among the most cost-effective ways to recycle carbon revenues to drive emissions reductions -- as long as these investments can be made separately from the political process.[65] Our proposal ensures that public funds would be invested professionally and according to strict criteria, and that the investment decisions would be insulated from the ebb and flow of the political process.

By using a competitive process that includes emissions-reduction potential and cost-effectiveness, Quebec will be able to allocate funding to the technologies that have the greatest likelihood of helping users achieve lower emissions. Ensuring funding is not sector specific allows funding to be allocated wherever emissions reductions can be best achieved.

Investing in new technologies will reduce the cost of achieving future emissions reductions, as companies develop technologies that make emissions reduction less onerous to their users. Focusing on technologies that lower the cost of emissions abatement necessarily prioritizes cost-effectiveness. Working with industry will drive the focus to be on cost-effectiveness, as firms receive pressure from investors to minimize their costs.

Investing specifically in mid-stage technologies allows funds to be spent where there is a market failure. Investments should not be made where venture capitalists or large funders such as BDC are available to provide financial support. Nor should investments provide support for projects that are at commercial stages, as it would simply displace capital from the market.

Fiscal Cost to Government: The funding to support innovation would come from the Green Fund and the amount available would depend on the amount of revenues received through the cap-and-trade system. We recommend between $200 million and $500 million is allocated to

[65] Canada's Ecofiscal Commission, "Choose Wisely: Options and Trade-offs in Recycling Carbon Pricing Revenues," April 2016. Retrieved from: http://ecofiscal.ca/wp-content/uploads/2016/04/Ecofiscal-Commission-Choose-Wisely-Carbon-Pricing-Revenue-Recycling-Report-April-2016.pdf

Investissement Quebec to ensure funding is diversified across several projects, while still providing enough funding to materially impact technology projects. This amount of funding is in line with the smaller Canadian funds, which range from $250 million to $1.2 billion.

***Political Feasibility*:** Support for investments in clean technology garner wide political support, as they are seen as positioning Quebec toward being a leader in innovation and technology. It allows for governments to support emissions reduction in industry at a lower cost, which is particularly important given that they are responsible for a significant share of emissions in the province and face major barriers to developing and adopting technologies. A public-opinion survey taken only four years ago indicates that Quebecers ranked clean-tech investments as their *top preference* for recycling carbon-pricing revenues.[66]

Additionally, the government is able to deliver positive news each time funding for a new technology or project is announced, as well as each time a technology achieves commercialization. It should be noted, however, that the government could face some criticism if technologies fail. For this reason, we recommend funding be allocated by an arms-length body, helping mitigate risk to the government.

Simplicity: Using Investissement Quebec's existing infrastructure simplifies the execution of this policy option. To minimize the amount of time required to successfully deploy this strategy, we do not recommend the Quebec government develop a new body to distribute this funding.

Case Study: Innovation Funding in Other Jurisdictions

In many jurisdictions, careful government investments have helped to spur the creation of technological hubs. Many technologies for which the United States has been at the forefront for decades have received government support, including computers, the Internet, robots, and space innovation.[67] DARPA, one of the leading international innovation centers, is driven by the US government, addressing a key market failure and allowing the United States to be at the helm of defense technology since its inception.

Israel, having decided that it wanted to be a leader in autonomous and electric vehicles in 2010, allocated $100 million of government resources to technology development. A decade later, they are world leaders and have supported 550 companies and 300 research groups through ongoing investments in vehicle technology.[68]

In Canada, governments have supported several technologies in reaching commercialization at national and international scales. Sustainable Development Technology Canada, the Strategic Investment Fund, Innovate BC, Alberta Innovates, Ontario, Innovation Demonstration Fund, and others are currently working to support technologies in overcoming the valley of death, an area that remains largely unaddressed in Quebec.

[66] Canada's Ecofiscal Commission, "Choose Wisely: Options and Trade-offs in Recycling Carbon Pricing Revenues," April 2016.
[67] Vernon W. Ruttan, "Technology, Growth, and Development: An Induced Innovation Perspective," New York: Oxford University Press, 2001.
[68] Fuel Choices and Smart Mobility Initiative, "Homepage". Retrieved from: https://www.fuelchoicesinitiative.com/

5.3 Option 2: Invest in Public Transit Infrastructure

The increased GHG emissions attributable to the transportation sector is partly attributable to the urban sprawl in most of Quebec's urban areas.[69] This type of development is associated with a high dependency on vehicle usage due to poor connections to public transportation.[70] In Quebec specifically, suburban areas shelter more people than core urban areas and have faster population growth than cities.[71] For that reason, the impacts of urban sprawl on emissions from passenger vehicles are likely to worsen significantly in the future, making it even more difficult to reduce GHG emissions from the transportation sector.

5.3.1 THE NEED FOR BETTER PUBLIC TRANSPORTATION IN QUEBEC

Quebec's need for better public transit has been extensively supported in recent years, especially in suburban areas. Just this winter, Sylvain Yelle, president of the *Autorité Régionale de Transport Métropolitain* (ARTM), called for new projects to develop public transit services in the outskirts of Montreal.[72] In Quebec City, many call for extension of the *Réseau de transport structurant de la Capitale* to the south-shore suburbs of the city.

In terms of public transportation investments, Quebec trails behind neighbouring Ontario. In the 2018-2028 *Plan Québécois des Infrastructures*, 69% of transportation infrastructure investments in Quebec were destined to road construction and maintenance, and only 31% to public transportation, such as buses, subways, and commuter trains. In Ontario, the reverse was true: 24% of investments were destined for better roads over the same period, and 76% for better public transit. On a per capita basis, Ontario plans to invest more than 5.2 times more than Québec on public transportation infrastructure over the years 2018-2028.[73]

Quebec's public transit systems need to be improved for commuting from a suburb to an urban center and even more for inter-suburban commuting, where the potential of public transit

[69] Urban sprawling is defined by the increase of the urbanized surface area because of low-density developments, generally single-family homes at the city's outskirts.
[70] Qiu Feng, Pierre Gauthier, "Urban Sprawl and Climate Change: A Survey of the Pertinent Literature on Physical Planning and Transportation Drivers," Ouranos, 2018. Retrieved from: https://www.ouranos.ca/publication-scientifique/ReportGauthier2019.pdf.
[71] David L.A. Gordon et al., "Still Suburban? Growth in Canadian Suburbs, 2006-2016," CanU, 2018. Retrieved from: http://www.canadiansuburbs.ca/files/Still_Suburban_Monograph_2016.pdf
[72] Bisson, Bruno, "Transport collectif dans les couronnes: des projets pour s'adapter aux besoins", La Presse, January 21, 2020. Retrieved from: https://www.lapresse.ca/actualites/grand-montreal/2020-01-21/transports-collectifs-dans-les-couronnes-des-projets-pour-s-adapter-aux-besoins
[73] Transit Québec, " Budgets provinciaux 2018-2019 - Investissements en transports en commun : un comparaison entre le Québec et l'Ontario". Retrieved from: http://www.transitquebec.org/wp-content/uploads/2018/06/Fiche-comparative-Investissement-TC-Québec-vs-Ontario.pdf

adoption is particularly high. Urban commuting is most important in the Montreal and Quebec City regions, where suburban residents have limited public-transit options.[74]

5.3.2 RECOMMENDATION #7: ALLOCATE NEW FUNDING TO PUBLIC TRANSIT INFRASTRUCTURE

We recommend the government allocate funds to support new public transit projects in urban areas and their suburbs.

Toward this end, the Quebec government should solicit new public transit proposals from municipalities that can address acute urban sprawl. Proposed projects could be evaluated based on the need for better public transit, the economic benefits, the GHG abatement potential, and other criteria. Among possible projects could figure an extension of the REM to connect suburban areas on a horizontal axis, or north and south of Montreal. Another possibility is an extension of the *Réseau structurant de transport en commun de la Capitale* to connect Quebec City to its south shore through public transit, and to connect many of its suburbs together.

The Green Fund already funnels significant amounts of money into public transit projects, including the *Programme d'aide gouvernementale au transport collectif des personnes (PAGTCP)* and the *Programme d'aide au développement du transport collectif (PADTC)*. While the Green Fund's current contribution to public transit is based on supporting the development of existing systems, it could help drive new projects to benefit Quebecers. It could also contribute to diversifying the funding sources for public transit investments, which are currently mostly funded through the *Plan Québécois des Infrastructures*.

5.3.3 EVALUATION CRITERIA

We briefly evaluate this policy proposal along the same criteria as used for the previous proposal.

Economic Growth: Investing in the construction of major public transit projects offers important economic benefits as it generates a major influx of public funds into various sectors of the economy. In the current economic context, private investments are expected to contract in the short run. Indeed, the province has experienced an 80% decline in lending activities between January and April of this year.[75]

[74] Between 1996 and 2016, 19.8% of the Montreal population and 25.3% of the Quebec City population commuted from a suburb to the city center, compared to 47% and 36.1% that commuted between two suburbs in the two cities, respectively. Yet, public transportation use for inter-suburban commuting is still way behind public transportation for traditional commuting in both cities (10.3% vs 54.6% in Montreal, and 4.9% vs 16% in Quebec City). Source: Statistiques Canada (https://www150.statcan.gc.ca/n1/pub/75-006-x/2019001/article/00008-fra.htm)

[75] Hugh MacArthur et al., "Covid-19 Hits Private Equity: The Early Data Is Not Pretty," Bain & Company, May 2020. Retrieved from: https://www.bain.com/insights/covid-19-hits-private-equity-the-early-data-is-not-pretty/

In such a context, and considering that a considerable portion of the Green Fund is currently not being spent, new government investments in public infrastructure would be a powerful tool to boost economic activity. Indeed, every dollar injected by the government into public transit projects would translate to a direct impact of more than a dollar to the economy, as government expenditure will generate income that local workers will spend and reinject into the economy.

Delays are to be expected between the initial government investment in transit infrastructure and the ensuing economic growth, as rounds of economic activity need to take place. But there will nonetheless be a lasting positive impact that goes well beyond the size of the initial fiscal stimulus. With the impact the pandemic recession expected to persist for many years, there is a sound rationale for forward-looking public transportation investments.

Moreover, investing in public transportation projects and the required infrastructure would provide indirect support to key Quebec industries, such as the wood, cement, aluminum and steel -- all sectors whose contribution to Quebec's GDP, job market and economic dynamism is significant.[76]

Finally, the significant cost of public transit projects should not appear as a disincentive for the government. If selected projects necessitate additional money from outside of the Green Fund, the current low interest-rate environment should allow the government to borrow additional funds at a very low cost. The current low interest-rate environment is an ideal time to build and finance long-lasting public infrastructure.

Emissions Reductions: New investments in public transit will be unlikely on their own to decrease total GHG emissions in Quebec because of the operation of the cap-and-trade system. As long as the cap-and-trade system is operating properly, the province's emissions will fall gradually, with or without new public transit. But new transit investments permit these emissions reductions to happen more easily, at a lower cost to families and businesses. With a more efficient public transport system, it is easier for Quebecers to reduce their driving, which will have become more expensive under the higher carbon price. Providing people with low-cost ways to change their driving behaviour helps lower the cost of the transition towards a low-carbon economy.

Cost-effectiveness: Investments in public transportation typically involve a large fiscal cost for governments. Available calculations around such investments show poor results in terms of cost-effectiveness -- meaning a high estimated cost per tonne of emissions reduced. However, these calculations often disregard the co-benefits of public transportation, such as better air quality, reduced noise pollution, less road congestion, safer commuting and higher-density land use.[77] [78]

[76] This is even more important given the recent trade instability for raw materials with the US.
[77] International Transport Forum, "Reducing Transport GHG Emissions: Opportunities and Costs," OECD, 2010. Retrieved from: https://www.itf-oecd.org/sites/default/files/docs/09ghgsum.pdf
[78] Pilon, Francis. "Les autobus tuent quatre fois moins que les voitures à Montréal", TVA Nouvelles. May 17, 2018. Retrieved from: https://www.tvanouvelles.ca/2018/05/17/les-autobus-tuent-quatre-fois-moins-que-les-voitures-a-montreal

In addition, the cost of public transportation projects is often not amortized over their full lifecycle. As such, it can be hard to put an accurate number on the cost-effectiveness of reducing emissions through new public transportation investments.

Fiscal Cost: The government's fiscal cost of public transit investments obviously depends on the scale and number of new projects undertaken. Quebec could design funding schemes that require municipal and federal participation, which would reduce the province's fiscal burden while generating the same impact on the economy.

Political Feasibility: Investing in public transportation involves a "Catch 22" regarding social acceptability. If existing public transit systems do not satisfy citizens, they will criticize new investments in public transit. Yet, only by investing in public transit can the systems be improved, and then garner widespread support. We can therefore expect political favourability for public transit investments to increase over time, as services improve.

In the short run, even if public transit investments receive strong support from users and environmental groups, a pushback could emerge from non-users and residents in rural areas, who see themselves excluded from these services. Using the Green Fund -- rather than more general government revenues -- to finance public transit projects might be the best way to increase acceptability by non-users since it would mitigate the perception of a competitive resource allocation between public transit and other public spending.

Simplicity: This option is as complex as any new public transit infrastructure. But it does not require new procedures, structures or institutions to be set up, as selected projects could follow the same process as any public infrastructure project. That process is nonetheless long, has many different steps and involves many different bodies and individuals to evaluate and approve the projects.

5.3 Option 3: Provide a Regular "Climate Dividend" to Quebec Residents

A third option for using some of the money inside the Green Fund, as well as any new revenues generated from ongoing auctions of allowances in the cap-and-trade system, is to return money directly to Quebec residents. They could use it anyway they like, and it could be advertised as their "dividend" in return for taking collective action in the fight against climate change. In addition, during the current difficult economic context, such a dividend would provide support to many citizens in need.

This option has appeal for several reasons, as we discuss below. But it is an especially appealing option if the government has difficulty in determining other, better options for spending the resources inside the Green Fund. Compared with bad investments, or with money sitting idle, giving money back to the people (after all, it came from them initially!) is both politically and economically sound.

5.3.1 RECOMMENDATION #8: PROVIDE QUEBECERS WITH A "CLIMATE DIVIDEND"

We recommend the government provide Quebec residents with a regular "Climate Dividend" to encourage climate action on a household level, increase the political feasibility of a more stringent cap-and-trade system, and support people during the economic recovery.

Using the freed-up money from the EV subsidy phase-out as well as any additional revenues generated from the allowance auctions, Quebecers would be mailed a cheque biannually thanking them for investing in their economy and their environment. Inside the envelope (or the email) could be a brochure offering suggestions on how to spend the money in ways that would help them reduce their own carbon footprint. Suggestions may include using the rebate to purchase public transit fares, bike or e-bike, buy locally grown food, installing a smart thermostat in their home, or invest in energy saving appliances.

There are two simple options available to the government for distributing these rebates, both with different distributive implications.

Give Equal Dividends to All Quebecers. The government could give all Quebec residents the same amount. This has the benefit of encouraging all Quebecers to see themselves as part of a collective effort to address climate change. Lower-income people will be more likely to spend the money on basic day-to-day expenses whereas higher-income people may be more able to allocate money to specific emissions-reduction expenditures, as they need less to cover their basic needs and generally have higher emissions than the average, providing more opportunities for emissions reduction.[79]

This approach would follow that used by the federal government. With the current federal "backstop" carbon tax (applying in several provinces currently, but not Quebec), rebates are given on an equal per-capita basis to all individuals in the province. The federal program returns approximately 90% of the revenues from the carbon tax to provincial residents.

Target Dividends to Lower-Income Quebecers. Alternatively, the government could choose to exclude higher-income individuals from the rebate and focus on supporting middle and low-income individuals, which would make the rebate progressive. This approach has two notable benefits: government can reduce the economic burden of the higher carbon price on those most affected by it, and by excluding higher-income people it permits the rebates to be larger for the lower-income individuals.

[79] Dubois, Ghislain and al., "It starts at home? Climate policies targeting household consumption and behavioral decisions are key to low-carbon futures", Energy Research and Social Science, Vol. 52, June 2019. Retrieved from: https://www.sciencedirect.com/science/article/pii/S2214629618310314

This approach would follow the one taken by Alberta's previous government. Under that carbon tax (which has now been repealed and replaced by the federal backstop policy), rebates were offered to roughly two-thirds of households, exempting those with the highest incomes. However, this approach has been criticized as being a hidden method of redistributing income within the province.

5.3.2 DO CARBON PRICING AND REBATES MAKE SENSE TOGETHER?

While it may seem contradictory and counterintuitive to tax people (through the carbon price) just to give the money back (through rebates), this combination of policies impacts behaviour without making people poorer. The carbon price is the lowest-cost policy to change behaviour in a way which reduces GHG emissions. But it also takes money out of people's pockets and reduces their purchasing power. By providing rebates to Quebecers, their purchasing power can be restored *even while they still face the incentives created by the carbon price to reduce their GHG emissions.*

As Quebec's carbon price increases in the years ahead, especially if even more aggressive climate action is adopted, this impact will be felt much more than it is today. The rebate will provide people with money back so that they ultimately are no worse off in terms of their overall purchasing power. That is, without the carbon price, behaviour would not change and emissions would not fall. But without the rebate, people would be poorer. The "climate dividend" is a way that Quebec can both achieve its emissions targets *and* maintain the prosperity of Quebecers.

5.3.3 EVALUATION CRITERIA

We briefly evaluate this policy proposal along the same criteria as used for the previous proposal.

Economic Growth: The post-covid economic recovery will prove challenging for Quebecers, and during these times, receiving some additional funds would be helpful to individuals and families. Providing people with funds that would otherwise go unused and remain in the Green Fund will stimulate the economy by encouraging spending.

Emissions Reductions: The "climate dividends" would not directly contribute to decreasing emissions. However, these rebates would ensure that future increases in the provincial carbon price (driven by the gradually falling cap on emissions) do not make people poorer. The rising carbon price will shift consumers' purchasing decisions towards lower-emissions goods and services. It will also produce a strong incentive to increase the production of low-carbon products and energy sources.

***Cost-Effectiveness*:** A higher carbon price provides the most cost-effective method to reduce Quebec's GHG emissions. Through increased political acceptability and the ability to absorb the impact of a higher carbon price, providing a "climate dividend" would allow governments to ratchet up the carbon price, and thus expand the role of the most cost-effective climate action available.

Fiscal Cost: The amount of money available for the "climate dividends" to Quebec residents would depend on the government's priorities and on whether it chooses to use the Green Fund for other programs. If half of the Green Fund was allocated to the dividends, residents would receive approximately $75 per adult and $30 per child, or $210 for a family of four annually, yielding a total annual cost of $550 million (approximately half of the current Green Fund).

As the carbon price increases in the years ahead, we recommend the same share of approximately half the Green Fund to be allocated to the dividend, and the amount allocated to each resident be determined accordingly. While this may not seem substantial at this time, as the carbon price increases, the amount of money received by each citizen would increase as well.

Political Feasibility: It is usually quite popular for governments to give money back to taxpayers. In this case, however, the government needs to ensure people that these "climate dividends" do not represent *an absence of climate action* on the part of their elected representatives.

Results from the new survey by Abacus Data point to this challenge. Only 48% of respondents rank the dividend option among their top four ways to spend the Green Fund. Rebates will not likely satisfy Quebecers' desire for the government to take action on climate, and the government should be cautious about a possible backlash.

The government should address this challenge directly and argue that such rebates play an essential role in allowing Quebec to take *more aggressive* climate action -- notably a tightening of the cap and a further increase in the carbon price. Increasing the stringency of the cap-and-trade system is politically challenging, though it is also the lowest-cost way to reduce emissions. By promising to put some of the additional revenues back into the pockets of Quebecers, the government can more likely get the support needed to ramp up the fight against climate change.

Simplicity: Of the three options we have examined in this report, issuing "climate dividends" is probably the easiest, by far. The rebates could be announced with a limited time horizon so that the program automatically sunsets after a few years or could be rolled out as an ongoing initiative. This provides the government with both flexibility and policy durability -- any successive government would face a challenge if they decided to terminate the dividends.

Case Study: Climate Rebates in British Columbia

Rebates have been widely used with carbon pricing to ensure people do not end up poorer than before the introduction of the carbon tax. British Columbia provides a carbon tax rebate with adults receiving up to $135 and children $40 annually.[80] At a price of $40 per tonne of emissions (nearly double Quebec's current price), rebates are approximately double the value recommended here.[81] British Columbia's rebates are on a sliding scale based on income.

[80] Government of British Columbia, "Carbon Tax Programs,". Retrieved from: https://www2.gov.bc.ca/gov/content/environment/climate-change/planning-and-action/carbon-tax/programs
[81] Government of British Columbia, "British Columbia's Carbon Tax,". Retrieved from: https://www2.gov.bc.ca/gov/content/environment/climate-change/planning-and-action/carbon-tax

SECTION 6

CONCLUDING REMARKS

Subsidies paid to purchasers of electric vehicles are naturally popular among those who likely benefit. But their use involves a myriad of problems, including:

(i) their ineffectiveness at changing purchasing behaviour;
(ii) their inability to reduce emissions within an existing cap-and-trade system;
(iii) their relatively high fiscal and economic costs; and
(iv) their undesirable redistributive effects.

Quebec's EV subsidies may have modestly increased EV adoption at early stages of the market, but any benefit on this front (which is still debatable) has come at a steep cost that merits a change in policy direction today. Many countries have begun phasing out EV subsidies and Quebec has a strong justification in considering such a step.

The phase-out of Quebec's existing EV subsidies by 2025 is this report's primary recommendation -- but all 8 recommendations are shown in the figure below.

If the government is still committed to providing support to the EV market -- and there are some (modest) benefits to EVs that are unrelated to climate change -- we have made four policy recommendations that are likely more effective and cost-effective than the use of EV subsidies. The government could phase-out the EV subsidies and adopt one or more of these alternative policies and still retain its reputation as being "pro EV".

A phase-out of the EV subsidies will free up over $200 million annually within the Green Fund. We have made three recommendations for ways to spend these funds -- to promote clean-tech innovation, improve Quebec's public transit infrastructure, and provide "climate dividends" to Quebecers. The government could adopt one or more of these three options and still leave its overall budget unaffected.

Reinvesting the funds in innovation, infrastructure, and in climate dividends will support economic activity and post-pandemic recovery. With these investments Quebec will continue to secure its role as a leader in climate policy within Canada and throughout the world, whether through becoming a clean-tech innovation leader or through clean public transit infrastructure.

In addition, all three of these policies ease the adjustment to a low-emissions economy for Quebec's households and businesses, and thus provide the government with an enhanced ability to adopt more aggressive climate action in the near future -- if it chooses to do so.

OUR RECOMMENDATIONS

Phase-Out EV Subsidies

Decrease EV subsidies by $2,000 each year, to be completely phased out by 2025 -- freeing up over $200 million annually.

IF THE QUEBEC GOVERNMENT IS COMMITTED TO CONTINUING ITS SUPPORT FOR EVS, THE FOLLOWING FOUR POLICY OPTIONS ARE PREFERABLE TO EV SUBSIDIES:

Increase the Stringency of the ZEV Mandate

The current ZEV mandate compliance credits should become more stringent by applying to a larger percentage of ZEV sales.

Require Charging Stations for New Buildings

All new commercial and residential buildings should be required to have 20% of the associated parking spaces equipped with EV charging capacity, while the remaining 80% of spaces must support the installation of charging stations in the future.

Extend HOV/EV Lanes

Since EVs are eligible to use HOV lanes, extend HOV/EV lanes in and out of major cities.

Scale-Up the Existing EV Information Campaign

The government should scale up its existing *Roulons électrique* information campaign and extend it until at least 2025.

FOR A MORE EFFECTIVE USE OF THE EXISTING GREEN FUND, THE GOVERNMENT SHOULD CONSIDER THE FOLLOWING POLICY OPTIONS:

Allocate Funding to Support Clean-Tech Innovation

The government should allocate funding to mid-stage clean-tech innovation to support businesses in achieving commercialization, reducing emissions, and accelerating Quebec in becoming an innovation hub.

Allocate New Funding to Public Transit Infrastructure

The government should allocate funds to support new public transit projects in urban areas and their suburbs.

Provide Quebecers with a "Climate Dividend"

The government should provide Quebec residents with a regular "Climate Dividend" to encourage climate action on a household level, increase the political feasibility of a more stringent cap-and-trade system, and support people during the economic recovery.

APPENDICES

Appendix 1
Glossary

EV	Electric Vehicle
GHG	Greenhouse Gases
ICEV	Internal Combustion Engine Vehicle
PACC	The 2013-2020 Climate Change Action Plan
PAVE	2011-2020 Action Plan on Electric Vehicles
PEV	Plug-in electric vehicle
SPEDE	Emissions cap-and-trade system
ZEV	Zero Emission Vehicle

Appendix 2
Roulez Vert Program Summary

ROULEZ VERT PROGRAM		
Subsidy Type	**Amount**	**Conditions**[82]
New Vehicle Rebate	Up to $8,000	▪ Manufacturer's suggested retail price (MSRP) is less than $60,000. ▪ To be applied to the list of eligible new vehicles. ▪ Rebate amount depends on the model of the vehicle. ▪ Bought or leased for long term (min.12 months). ▪ Car registered in Québec between 2016 and 2020. ▪ Have a battery capacity of at least 4 kWh. ▪ Bought in Canada and registered in Québec for the first time and never have been registered outside of Québec. ▪ For a maximum of 3 vehicles per person.
Used Vehicles Rebate	Up to $4,000	▪ The second-hand vehicle must not have received a Quebec subsidy when bought new. ▪ Excludes off-road vehicles. ▪ The subsidy does not apply to transactions between individuals (only between a car dealer and an individual).
Home Charging Station	$600	▪ Applicable to a 240V charging station. ▪ The applicant must be the owner or lessee of an EV. ▪ Applicable to admissible list of charging stations.
Charging Stations at Work	Up to $5,000 per connector	▪ Applicable to new charging stations only. ▪ Applicable to a 120 or 240V charging station. ▪ Applicable to admissible list of charging stations. ▪ Be used to recharge electric vehicles owned by the eligible applicant or their or her employees.
Multi-Unit Building Charging Station	Up to $5,000 per connector	▪ For buildings located in Québec, with residential or mixed use, with five or more residential units. ▪ For new, Level 2 charging stations only. ▪ Be operated by the applicant for at least 3 years following payment of the financial assistance.

[82] Transition énergétique Québec, "Roulez vert - Cadre normatif", Gouvernement du Québec. Retrieved from: https://vehiculeselectriques.gouv.qc.ca/assets/pdf/Cadre-normatif-Roulez-vert.pdf
[83] Transition énergétique Québec, "Véhicules admissibles", Gouvernement du Québec. Retrieved from: https://vehiculeselectriques.gouv.qc.ca/rabais/ve-neuf/vehicules-neufs-admissibles.asp

Appendix 3
EV Lifecycle Analysis for Other Jurisdictions[84]

Tableau 2-11 : Résumé des études comparatives récentes (depuis 2012) entre les véhicules conventionnel et électrique

Auteur	Année	Contexte géographique	Comparaison	Unité fonctionnelle	Catégories d'impacts considérées	Méthode d'évaluation des impacts du cycle de vie et niveau des évaluations des impacts du cycle de vie	Favorise
Renault	2011	Europe	Fluence (diesel, essence, électrique)	Durée de vie des véhicules (150 000 km)	Toutes les catégories considérées par la méthode	CML (problème)	Pas de favori net
Aguirre et coll.	2012	États-Unis / Californie	Nissan Leaf, Nissan Versa et Toyota Prius	1 mile à un moment indéterminé lors de la durée de vie du véhicule	Changement climatique	IPCC (problème)	Véhicule électrique
Warburg et coll.	2013	Europe / Belgique	Véhicule comparable de classe B	Durée de vie des véhicules (150 000 km)	Toutes les catégories considérées par la méthode	CML (problème)	Pas de favori net
Hawkins et coll.	2013	Europe	Nissan Leaf avec Mercedes Benz A	Durée de vie des véhicules (150 000 km)	Toutes les catégories considérées par la méthode	ReCiPe (problème)	Pas de favori net
Fayçal-Siddikou et coll.	?	Europe / Belgique	Valeurs de la littérature	Durée de vie des véhicules (230 500 km)	Toutes les catégories considérées par la méthode	ILCD (problème)	Pas de favori net
Messagie et coll.	2014	Europe	Volkswagen Golf A4 et Nissan Leaf	1 km en Europe	Changement climatique, acidification, épuisement des ressources minérales et effets respiratoires	CC : IPCC 4 Acidification : CML Minéraux : Eco-indicator99 Effets respiratoires : IMPACT 2002+ (tous : problèmes)	Pas de favori net
Nealer et coll.	2015	États-Unis	Véhicules comparables intermédiaires	Durée de vie des véhicules (217 256 km)	Changement climatique	Non précisée	Véhicule électrique

[84] Centre international de référence sur le cycle de vie des produits, procédés et services (CIRAIG). "Rapport Technique: Analyse du cycle de vie comparative des impacts environnementaux potentiels du véhicule électrique et du véhicule conventionnel dans un contexte d'utilisation québécois". Avril 2016. Consulté à l'adresse suivante: https://www.hydroquebec.com/data/developpement-durable/pdf/analyse-comparaison-vehicule-electrique-vehicule-conventionnel.pdf

Appendix 4
Quebec's EV Charging Infrastructure

Quebec's public charging infrastructure includes 5,209 240V charging stations, 401 480V charging stations and 162 Tesla Superchargers.[85] [86] The online platform *Charge Hub* displays the location of most public charging stations in Quebec, as well as in any other jurisdiction within Canada and the US.[87] Québec's public charging infrastructure is one of the most extensive in North America. Indeed, Québec benefits from its publicly owned and operated hydroelectricity utility, Hydro-Québec, which has supported the installation and operation of charging stations throughout the province.[88]

Most of the public charging infrastructure is managed by two networks. Hydro-Québec manages *Le Circuit Électrique*, which includes more than 2,300 charging points. They are situated on streets and highways, or in parking of major commercial businesses like *Rona* or *Métro L'épicier*. These charging points can be found through the *Circuit Électrique* mobile app. The second major network belongs to FLO, that has 1,100 public charging stations and 5,350 charging stations in private businesses parking for their employees, and in apartment buildings. Finally, there are various smaller private charging station networks. Petro-Canada and Tesla also provide such services.

If most EV drivers recharge their vehicles at home rather than at public charging points, equipping Quebec's wide and unpopulated territory remains a significant challenge.[89]

[85] 240V charging stations provide an autonomy of 40km per hour charging. 400V charging stations provide an autonomy of 250km per hour charging. Tesla Superchargers provide an autonomy of 540km per hour charging.
[86] https://www.aveq.ca/actualiteacutes/statistiques-saaq-aveq-sur-lelectromobilite-au-quebec-en-date-du-31-mars-2020-infographie
[87] Charge Hub, 2020 Retrieved from: https://chargehub.com/fr/index.html
[88] Low-carbon innovation from a hydroelectric base: The case of electric vehicles in Québec. Brendan Haley
[89] Association des véhicules électriques du Québec, "Statistiques SAAQ-AVÉQ, sur l'électromobilité au Québec en date du 31 mars 2020 [Infographie]. Retrieved from : https://www.aveq.ca/actualiteacutes/statistiques-saaq-aveq-sur-lelectromobilite-au-quebec-en-date-du-31-mars-2020-infographie

Appendix 5
Projects Currently Financed by the Green Fund

SECTOR	PROJECTS
Energy	▪ Programme ÉcoPerformance – TEQ ▪ Programme de biomasse forestière résiduelle – TEQ ▪ Programme Chauffez vert – TEQ ▪ Programme visant à rendre les établissements d'enseignement écoresponsables – MEES
Transport	▪ Programme d'aide financière au développement des transports actifs dans les périmètres urbains (TAPU) – MTQ ▪ Programme d'aide gouvernementale au transport collectif des personnes (PAGTCP) – MTQ ▪ Programme d'aide à la réduction des émissions de gaz à effet de serre dans le transport routier des marchandises – ÉcoCamionnage– MTQ ▪ Programme d'aide gouvernementale à l'amélioration de l'efficacité du transport maritime, aérien et ferroviaire (PETMAF) en matière de réduction des émissions de GES – MTQ ▪ Programme Roulez vert – TEQ ▪ Programme d'aide au développement du transport collectif (PADTC) – MTQ ▪ Programme de soutien à la promotion de l'électrification des transports – MTQ ▪ Programme visant la réduction ou l'évitement des émissions de gaz à effet de serre par le développement du transport intermodal (PREGTI) – MTQ
Research and Innovation	▪ Programme Climat municipalités - Phase2 – MELCC ▪ Programme Technoclimat – TEQ ▪ Programme de soutien aux municipalités dans la mise en place d'infrastructures de gestion durable des eaux de pluie à la source – MAMH ▪ Programme de vitrine technologique pour les bâtiments et les solutions innovantes en bois – MFFP ▪ Programme de formation continue sur l'utilisation du bois dans la construction – MFFP ▪ Programme de soutien à l'intégration de l'adaptation aux changements climatiques à la planification municipale (PIACC) – MAMH et MSP

Rehabilitation of contaminated land	▪ Programme d'aide à la réhabilitation des terrains contaminés - ClimatSol-Plus - Volet 1 – MELCC
Residual materials and agriculture	▪ Programme de traitement des matières organiques par biométhanisation et compostage (PTMOBC) – MELCC ▪ Programme d'aide financière pour le compostage domestique et communautaire (ACDC) – MELCC ▪ Programme de soutien aux essais de fertilisation – MAPAQ
Awareness-raising, partnerships and government exemplarity	▪ Programme Action-Climat Québec – MELCC
International Climate Cooperation	▪ Programme de coopération climatique internationale (PCCI) – MELCC

Appendix 6
Abacus Data Survey Results

In the context of producing this report, the research team contracted the firm Abacus Data to develop and run a survey on Quebecers' thoughts, beliefs and behaviours regarding EVs. The survey was conducted on 1,000 residents of Quebec from August 6 to August 10, 2020. A random sample of individuals were invited to complete the survey. The data was weighted according to census data to ensure that the sample matched Quebec's population along age, gender, educational attainment and region considerations. The margin of error of the survey is +/- 3.08%, 19 times out of 20.

The purpose of conducting this survey was to better understand how Quebecers perceive EVs, their vehicle purchasing behaviors and their beliefs regarding the current market for EVs.

Following are takeaways and key findings from that survey.

- 56% of respondents that were EV owners said that they would have certainly, probably or maybe bought an EV even if the subsidy had not been available.
- 81% of EV owners said they would recommend EVs without hesitation, while 19% said they liked their EV even though it is not *perfect*. This represents 100% of relative satisfaction from EV owners.
- Only 15% of respondents said they would never own an EV. 57% said they would love to own, or were interested in owning, an EV. The remaining 28% said they were hesitant but open to purchasing an EV.
- Respondents were more inclined to consider purchasing an EV in the more distant future than in a more immediate time frame.
- In choosing between an EV and an ICEV, respondents awarded a lot of importance to the cost of purchasing, maintaining and fueling the vehicle. They also awarded importance to the environmental impact, the accessibility of charging/fueling infrastructure, the reliability of the vehicle and winter performances, amongst others.
- 78% of respondents said they believe EVs will become more popular in the future, and 68% believe that their price will become more competitive.
- When asked about the importance of a vehicle that corresponds to their needs, that reflects their personal values or that is best for the environment, respondents awarded more importance to a vehicle that corresponds to their needs over the two other options.
- When asked about whether some barriers to EV adoption were a concern to them, respondents did not discriminate amongst the options and identified them all like concerns, at varying yet similar degrees.
- 62% of respondents said that they expect their next vehicle to cost lower than $39,999.
- 84% of respondents said they were in favor of government policies to support EV adoption.

- Just as with barriers to EV adoption, respondents did not really discriminate between policies to favor EV adoption. They seemed to support any policy, which suggests that the subsidy for purchasing an EV is not the one and only policy tool respondents cared about.
- 61% of respondents said they would be a lot more likely or somehow more likely to purchase an EV soon if they knew that the subsidy would eventually be abolished.
- Better and more accessible public transportation was identified as the most preferred option to help reduce vehicle usage, followed by increased prices for motor vehicles, more HOV lanes, better active transportation options and improved access to vehicle sharing, amongst others.
- When asked about their priorities regarding the use of the Green Fund's money, respondents did not discriminate between most policy options (EV subsidy continuation, better waste management, better charging infrastructure network and supporting innovation), supporting them all in a similar proportion. The instauration of a $100 green rebate received particularly low support, with 52% of respondents not ranking it at all as one of their top four priorities.

Appendix 7
Quebec's EV Market – Consumer Profile

A recent survey by the *Association des véhicules électriques du Québec* suggests that the average EV owner is male (87%), between 46 and 55 years old, with an income ranging from $70,000 to $80,000 and that:

- 91% of EV drivers are owners, with 84% of them owning a charging station at home.
- 44% of EV drivers have access to a charging station at work.
- 51% of EV owners possess a gas car as their second vehicle.
- 96% of EV owners are either "very satisfied" (28%) or "fully satisfied" (68%) with their electric vehicle.
- 92% of respondents said that their next vehicle will be 100% electric.
- 75% of members said that their choice to purchase an EV was based on environmental reasons, while 53% said it was based on economic reasons.

EV owners drive on average 14km to get to work, with their longest trip averaging 399km, for an annual total of 20,000km. 400km is believed to be the adequate distance range for an EV.

The most popular EV in Quebec is the Chevrolet Volt, with a market share of 17% of EVs. It is followed by the Nissan Leaf (13%) and the Tesla Model 3 (12%).