

1 **Q. Please provide any recent reports or analyses conducted by Newfoundland Power**
2 **assessing electrification possibilities for its service territories, or for the Province.**
3

4 A. Newfoundland Power has conducted research on the electric vehicle market, including
5 potential adoption locally and related economic benefits. The *Electric Vehicle Market*
6 *Assessment* report is provided as Attachment A to this response.
7

8 In 2018, as part of an annual Newfoundland Power survey, customers were asked to assess
9 their probability of purchasing an electric vehicle in the next 5 years. Approximately 17%
10 of respondents were somewhat or very likely to purchase an electric vehicle. The 2 largest
11 barriers to electric vehicle adoption were: (i) the cost of purchasing an electric vehicle
12 (27%); and (ii) the fact that respondents were not planning to purchase a new vehicle in
13 the foreseeable future or had recently purchased a new vehicle (23%). Detailed
14 information on the survey results is provided as Attachment B to this response.
15

16 Newfoundland Power is currently working with Newfoundland and Labrador Hydro to
17 complete a new Conservation Potential Study. The study is expected to be completed by
18 mid-2019 and will include an assessment of electric vehicle adoption potential in the
19 province from 2020 to 2035. This will consider local market conditions and how various
20 pricing and infrastructure factors will impact adoption, as well as electrical system impacts
21 and strategies to optimize demand management at various adoption rates.
22

23 The new Conservation Potential Study will also assess the potential for fuel switching to
24 electricity in the residential and commercial sectors. This will include analyzing the size
25 of the market, conducting cost benefit analysis of conversion, and the potential for fuel
26 switching incentives.

Electric Vehicle Market Assessment Report



Plugging in on the Rock

Electric Vehicle Market Assessment

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Executive Summary

Transportation costs are one of the biggest financial decisions a consumer makes. Consumers consider many factors when purchasing a vehicle including price, operating costs and lifestyle. Since 2010, electric vehicles (“EVs”) have become an increasingly competitive option in the vehicle marketplace.

In 2017, the estimated global electricity demand from all types of EVs was 54 terawatt-hours.¹ That is enough electricity to power all of Newfoundland Power’s service territory for nine years. In that same year, the number of EV passenger vehicles reached 3 million worldwide, representing an almost 60% increase over the number of EVs in 2016. China has the largest EV market, accounting for almost 50% of the units sold in 2017, followed by the United States. EV sales in Canada continue to grow as well.

EV growth is driven by public policy measures including: (i) financial incentives (ii) tightened regulations on the emission of pollutants, (iii) low and zero emission vehicle mandates, (iv) investments in charging infrastructure, and, (v) public education and awareness initiatives.

There are a number of barriers that may impact expected EV growth. These barriers are typically the upfront capital cost, access to charging infrastructure and public perceptions about EVs. In many countries, including Canada, public policy measures have been introduced to remove barriers and advance the EV market. These have largely been related to government greenhouse gas (“GHG”) emission reduction targets. Vehicle manufacturers are also implementing strategies that will help increase the adoption of EVs globally.

EV growth is expected to continue across the globe. Bloomberg New Energy Finance predicts that EVs will achieve price parity with conventional vehicles by 2025.² They also project that 55% of all new global car sales will be electric by 2040.³

The Muskrat Falls project will connect the province to the North American electricity grid. As a result, surplus electricity will be available in Newfoundland and Labrador to fuel an EV market. The development of new electricity markets is an opportunity to mitigate the impact of the Muskrat Falls project costs. The net revenue gained from domestic sales could be used to offset the revenue that must be recovered to pay for the Muskrat Falls project.

Further analysis is required to determine the impacts of EV adoption on the provincial electrical system. Additionally, research and collaboration between governments and utilities is needed to determine the appropriate achievable mix of public policy measures required to increase EV adoption in Newfoundland and Labrador.

¹ See International Energy Agency, *Global EV outlook*, 2018.

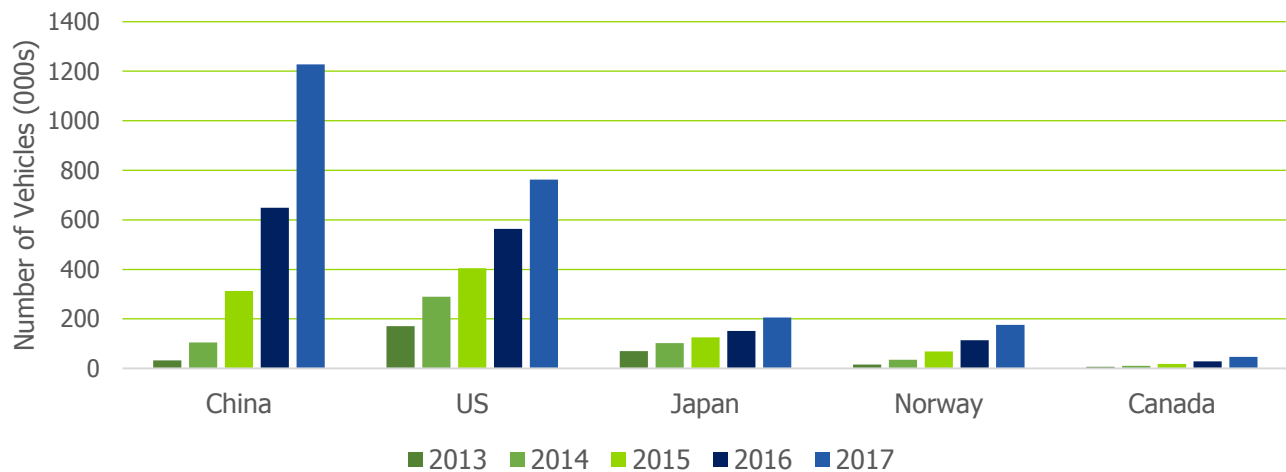
² See Bloomberg New Energy Finance, *Electric cars to reach price parity by 2025*, June 2017.

³ See Bloomberg New Energy Finance, *Electric vehicle outlook 2018*.

EV Markets

Global EV stock is expanding rapidly. The number of EVs worldwide reached 3 million in 2017.⁴ This is an almost 60% increase over the number of EVs in 2016. As of September 2018, EVs have reached 4 million units worldwide.⁵

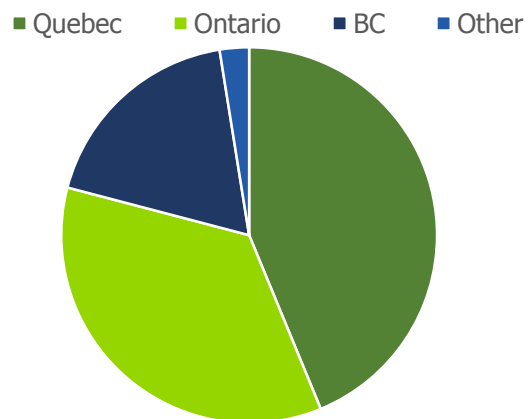
**EV Stock by Select Country
2013-2017**



From 2013 to 2015, the United States led EV growth globally. In 2016, China began offering substantial EV subsidies that accelerated EV sales growth, surpassing the United States as the global leader. China now has the largest EV car stock with almost 1.3 million EVs sold, or approximately 40% of units sold worldwide. The United States has the second-highest number of EVs sold.⁶

The greatest market penetration is in Norway. By mid-2018, 47% of all new cars sold in Norway were EVs.⁷ Norway has the widest array of EV incentives and has a goal of 100% zero-emission vehicles by 2025.

2017 EV Sales in Canada by Province



⁴ See International Energy Agency, *Global EV outlook*, 2018.

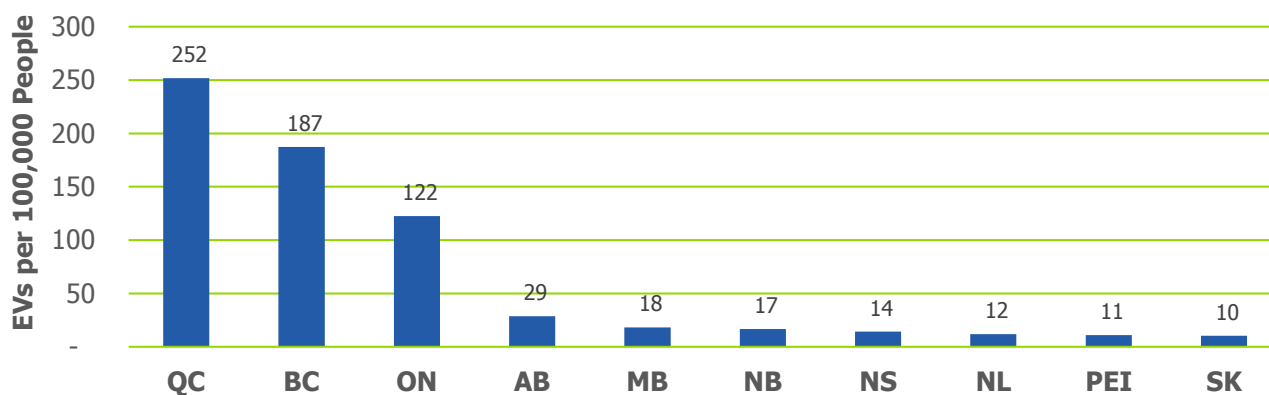
⁵ See Bloomberg New Energy Finance, *Cumulative global EV sales hit 4 million*.

⁶ See International Energy Agency, *Global EV outlook*, 2018.

⁷ See World Economic Forum, *Electric vehicles are half the market in Norway*, September 3, 2018.

EV sales in Canada vary significantly across the provinces. Almost 96% of the 48,000 EVs sold in Canada by the end of 2017 were in Quebec, Ontario, and British Columbia.⁸ These provinces are the only jurisdictions which have strong public policy supports in place and have invested in expanding access to charging infrastructure.⁹ Newfoundland and Labrador has the third lowest number of EVs on a per capita basis, with just 63 in the province, almost 30% of which were purchased in 2017.¹⁰

Number of EVs per Capita in Canada



EV Market Drivers

Policy Measures

EV growth has mainly been driven by public policy measures. Policy measures typically include a combination of: (i) financial incentives, (ii) tightened emissions regulations, (iii) low and zero emission vehicle mandates, (iv) investments in charging infrastructure, and, (v) public education and awareness initiatives.

In China, national subsidies have played a large role in the adoption of EVs. China is expected to continue to invest heavily in the EV market, viewing the electrification of transportation as a major strategic industry over the coming decades. The country is predicted to continue to be the largest EV market in the world through 2040. Beginning in 2019, China will introduce a policy which will require automakers of a certain size to ensure that 10% of vehicle sales are EVs.¹¹

Progressive public policies in Europe are also expected to accelerate EV adoption. Some European countries are considering a ban on conventional vehicle sales before 2050. Ireland, the Netherlands and Germany are proposing bans as early as 2030.¹² Norway, which has the most attractive incentives

⁸ See Electric Mobility Canada, *Annual Report 2017*.

⁹ See Appendix B: Canadian Regulatory Experience and Appendix C: Canadian EV Incentive programs.

¹⁰ Information provided by Service NL.

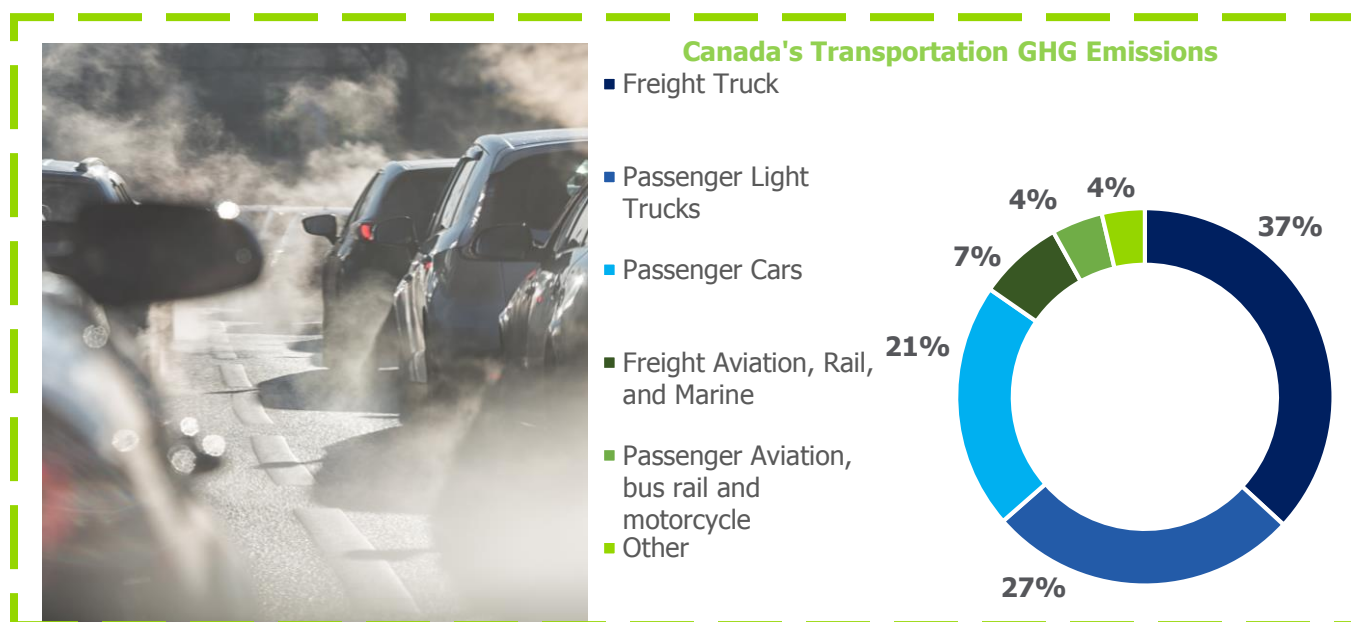
¹¹ See Bloomberg Business, *China gives automakers more time in the world's biggest EV plan*, September 2017.

¹² See The Guardian, *EU must end new petrol and diesel sales by 2030 to meet climate targets*, September 2018.

globally, is leading the transition to EVs. Consumers who buy an EV benefit from incentives such as exemption from import or purchase taxes and 25% value added tax. They also avoid road tax, road tolls, pay half price on ferry transit, receive free municipal parking and are permitted to use bus lanes.

The Zero Emission Vehicle ("ZEV") program has been one of the strongest drivers for EV development in the United States. Since 2013, 10 states have adopted the program which requires that automakers offer zero emission vehicles to improve local air quality and reduce the emissions contributing to climate change.¹³ Quebec and British Columbia have adopted similar policy mandates.¹⁴

In Canada, a number of provinces partnered with the federal government to take advantage of \$180 million included in the 2016 and 2017 federal budgets for EV and alternative fuel infrastructure. Public policy measures which increase EV development can assist the federal and provincial governments in meeting their GHG emission reduction targets, as the transportation sector accounts for 24% of GHG emissions in Canada.¹⁵



Barriers

In order to advance EV adoption, a number of barriers must be removed.

EV market barriers are typically the upfront capital cost, access to charging infrastructure, and public perceptions about EVs. EVs typically have a higher up front purchase cost than conventional vehicles

¹³ The 10 states that adopted the ZEV program are: California, Connecticut, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Rhode Island, and Vermont.

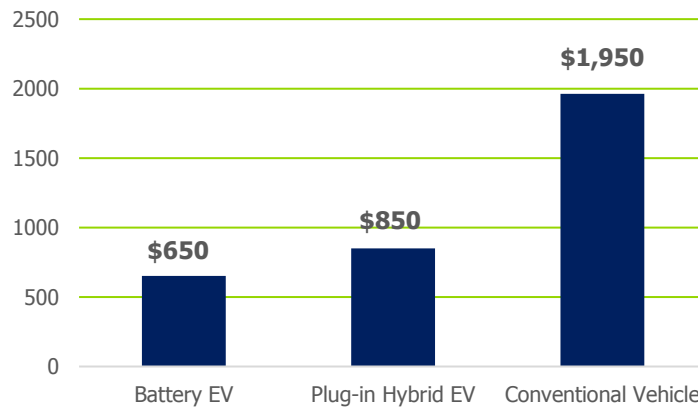
¹⁴ See Canada's National Observer, *B.C.'s zero emission vehicle mandate may be the toughest in North America. Here's what you need to know*, November 2018.

¹⁵ See Natural Resources Canada, *Accelerating the deployment of zero emission vehicles: Atlantic Canada and the Prairies*, March 2018.

but lower ongoing operating costs. The typical incremental capital cost difference between a conventional family sedan and a similar model EV is approximately \$19,000.¹⁶ The main cost driver for EVs is the large battery that represents approximately 75% of the vehicle's power train cost.¹⁷ Fuel costs on the other hand are approximately 60%-70% lower for an EV compared to a conventional vehicle.¹⁸



Annual Fuel Cost of an EV vs. Conventional Vehicle



Once Muskrat Falls come online, even if rates increase to \$0.17/kWh, fuel costs will still be, on average, 40-50% lower for an EV.

A real or perceived lack of charging infrastructure creates the consumer perception that EVs will run out of battery power and be left 'stranded' or unable to reach their destination. A report published by Bruce Power L.P., Plug'n Drive, Pollution Probe and University of Waterloo states that 92% of Canadians believe there are very few places to charge EVs outside the home, and that 86% of Canadians don't realize charging an EV at home is an option.¹⁹ Despite research that shows most charging events occur at home, drivers want the extra security that comes from sufficient public access to EV charging.²⁰

¹⁶ The purchase price of six EVs were compared to similar internal combustion engine vehicles. The average difference in price between EVs and the internal combustion engine vehicles was \$18,650.

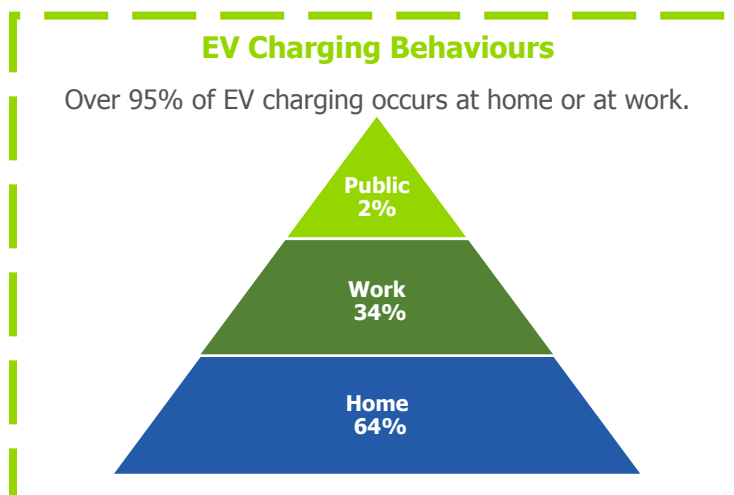
¹⁷ Power train typically consists of the main components of a vehicle that generate power. This typically includes the engine, transmission, drive shafts, etc.

¹⁸ Based on electricity rates as of July 2018 (\$0.11391/kWh).

¹⁹ See Bruce Power L.P., Plug'n Drive, Pollution Probe and University of Waterloo, *Accelerating the deployment of plug-in electric vehicles in Canada and Ontario*, 2016.

²⁰ See Esource, *EV charging technology and trends can guide utility strategy*, November 2015

In most cases, the distance that EV drivers travel each day is well within the range capacity of an EV. For example, the average passenger vehicle in Newfoundland and Labrador travels approximately 50 km each day.²¹ The range that EVs can travel in a single charge has been increasing in recent years. The average range has grown from 117 km in 2011, to 183 km in 2017.²² Based on this range capacity, the 50 km traveled each day by drivers in Newfoundland and Labrador can be accommodated.



Despite advances in vehicle capacity, EV charging is impacted by temperature; especially colder temperatures. The range of an EV can be reduced by approximately 50% in below-freezing temperatures, mostly due to the operation of the vehicle’s heating system.²³ Under these conditions, twice as much electricity is required to charge the vehicles for daily use.

Consumer knowledge and public perceptions about EVs are another barrier to EV adoption. A consumer survey conducted by McKinsey & Company in 2017 shows that 50% of all consumers today are not yet familiar with EVs and related technology.²⁴ There are also difficulties with EV availability at dealerships and limited local service and maintenance options. In addition, many auto dealers are unaware or uninformed about EVs. A 2018 survey of auto dealerships conducted for the Government of Canada shows that 1/3rd of respondents knew little about operating costs, range, and where to find charging stations.²⁵ Experience in other jurisdictions indicates this barrier can be addressed through public education initiatives.

²¹ Natural Resources Canada, *2008 Canadian vehicle survey update report*, 2008.

²² Electrek, Median electric car range increased by 56% over the last 6 years, December 2017.

²³ AAA, *AAA Electric Vehicle Range Testing*, February 2019.

²⁴ McKinsey & Company, *Electrifying insights: How automakers can drive electrified vehicle sales and profitability*.

²⁵ See the Financial Post, *Electric vehicle sales growing, but supply, lack of knowledge remain barriers*, August 20, 2018.

EV Outlook

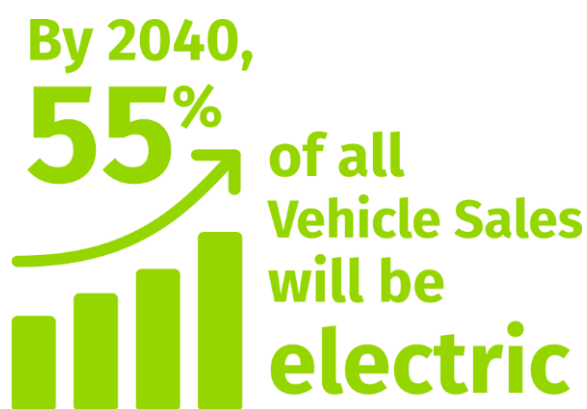
Future Projections

The outlook for the degree of future EV sales growth varies.

Navigant Research's conservative forecast places the EV market at over 7 million units sold globally in 2025.²⁶ An aggressive scenario sees the global market maintain around a 30% growth rate through the forecast, achieving over 13.5 million sales in 2026. This range of scenarios produces a global population of between 39 million and 57 million EVs in 2026. In addition, Bloomberg New Energy Finance predicts that EVs will achieve price parity with conventional vehicles by 2025. They also project that 55% of all new car sales will be electric by 2040.²⁷

China is expected to lead EV adoption, with sales accounting for almost 50% of the global EV market in 2025, and 39% in 2030. EVs will account for 19% of all passenger vehicle sales in China in 2025.²⁸ Market share in 2025 is forecast to be 14% in Europe and 11% in the United States.²⁹

Future expected growth is based on the continued strengthening of public policy measures, financial incentives and fuel efficiency standards.



Potential Risks

Although strong growth of EVs is projected, there is also a significant degree of uncertainty.

Policy changes in the United States have reduced pressure on manufacturers for EV production by decreasing the penalties of non-compliance with Corporate Average Fuel Economy (CAFE) and GHG standards.³⁰ A more significant setback to the United States market would be the elimination of federal tax credits for EV purchases. This change would have immediate repercussions in terms of EV sales and thus make compliance with CAFE, GHG, and ZEV standards difficult and costlier for automakers.

²⁶ Navigant is a market research and advisory firm that provides subject matter expertise and an extensive library of data related to the power & utilities industry. See Edison Electric Institute, *Plug-in Electric vehicle Sales forecast through 2025 and the charging infrastructure required*, June 2017.

²⁷ See Bloomberg New Energy Finance, *Electric vehicle outlook 2018*.

²⁸ See World Economic Forum, *China is leading surge in electric vehicle sales*, May 2018.

²⁹ See Bloomberg New Energy Finance, *Electric vehicle outlook 2018*.

³⁰ Corporate Average Fuel Economy standards are regulations enacted by the United States Congress in 1975 to improve the average fuel economy of cars and light trucks produced for sale in the United States.

Another potential risk to the EV market is the cobalt shortage that is predicted to occur in the early 2020s.³¹ A shortage could slow down the battery cost declines seen recently as cobalt is a primary material used in EV batteries.

EVs in Newfoundland and Labrador

Background

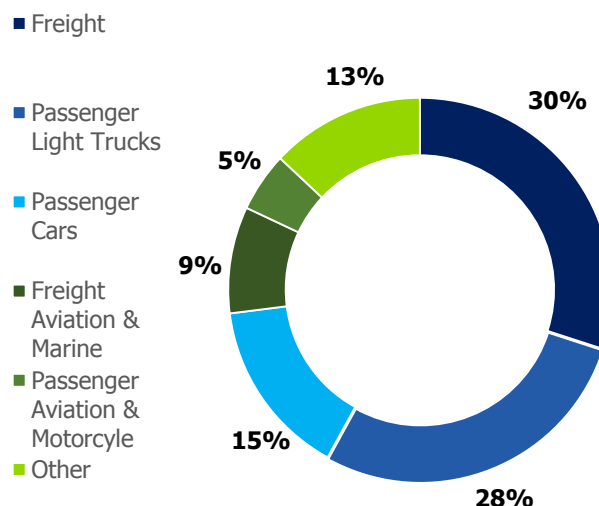
The transportation sector in Newfoundland and Labrador represents 34% of provincial GHG emissions.

The Government of Newfoundland and Labrador set a goal to reduce GHG emission levels within the transportation sector.³² Government fulfilled its commitment to “examine the state of technology, infrastructure requirements and market developments for EVs”.³³

Passenger cars and light trucks represent over 40% of the province’s transportation GHG emissions.³⁴ As such, this segment offers a significant opportunity to reduce GHG emissions and meet provincial climate change objectives. Starting in 2018, the federal government has mandated that provinces and territories have a carbon pricing plan in place.³⁵

The Government of Newfoundland and Labrador released its carbon pricing plan in the fall of 2018.³⁶ New revenue generated through the provincial carbon pricing plan could be reinvested to assist in the development of the provincial EV market and support the province in meeting its GHG emission reduction targets.

Transportation GHG Emissions in Newfoundland and Labrador



³¹ See Bloomberg, *Threat of cobalt shock is a top risk for electric vehicles*, May 2018.

³² See Government of Newfoundland and Labrador’s *Charting our Course: Climate Change Action Plan*. This plan commits to reducing provincial GHG emissions to 10% below 1990 levels by 2020, and 75 to 85% below 2001 levels by 2050.

³³ See Government of Newfoundland and Labrador’s *Electric Vehicle Report*, November 2015.

³⁴ Data provided by the Government of Newfoundland and Labrador.

³⁵ This pricing must be in the form of either a direct price on carbon starting at \$10 per tonne, rising by \$10 each year to \$50 per tonne in 2022; or a cap-and-trade system with emission reductions equal to both Canada’s target and the reductions expected in places with a direct price.

³⁶ See Government of Newfoundland and Labrador’s *NL Carbon Plan*, October 2018.

Electrical System Outlook

The surplus electricity generated from the interconnection of the Muskrat Falls project could support potential new load growth associated with an EV market.

Generating assets at Muskrat Falls are expected to produce approximately 5 TWh of energy by 2020. Approximately 2 TWh will be reserved to meet Newfoundland and Labrador's electricity requirements; however, this amount may be in excess of provincial needs. Emera will receive approximately 1 TWh for 35 years. The remaining surplus of 2 TWh, along with any energy in excess of domestic needs, will be available to be sold on the North American market.³⁷ Potential exports of surplus electricity generated at Muskrat Falls would face price competition tied to natural gas on the North American market that are estimated to be as low as \$0.037/kWh.³⁸

Alternatively, surplus electricity could be sold to new electricity markets within the province. If the revenue that could be generated from additional sales within the province exceeds that available in export markets, then selling the surplus electricity domestically to serve new load growth is a potentially attractive proposition.



EV Fleet Opportunities



A number of jurisdictions in Canada and the United States are investigating the cost effectiveness of electrifying public transportation. For example, the transit authorities in the City of Montreal operate a battery electric bus pilot program with the aim of becoming fully electric in the future. The city recently ordered 30 new battery electric buses. This pilot is supported by provincial and federal funding.¹ Other Canadian municipalities have made similar investments such as Edmonton, Charlottetown, Toronto and Halifax.

¹See New Flyer. *New Flyer awarded contract for 40 electric buses from Montreal and Laval*

³⁷ Government of Newfoundland and Labrador, Department of Finance. The total number of road vehicle registrations is 391,934. If all of these vehicles were converted to EVs, the total energy required, based on average use of 5,000 kWh, equals approximately 1.96 TWh (391,934 x 5,000 kWh = 1.96 TWh). If such conversion occurred, almost the entire surplus of 2 TWh could be utilized.

³⁸ See Nalcor's *2018 3rd Quarter Report*, 2018.

Increased domestic market sales will benefit all electricity customers. The development of new electricity markets within the province is an opportunity to mitigate the impact of the Muskrat Falls Project costs on existing island customers' rates. The net revenue gained from additional sales within the province could be used to reduce the overall revenues that must be recovered from customers.³⁹

The development of an EV market in Newfoundland and Labrador is expected to have minimal impacts on the electrical distribution system in the near term. It would take approximately 12,000 EVs to increase Newfoundland Power's energy sales by 1%, or approximately 0.06 TWh. In comparison, Newfoundland Power's energy sales have grown by approximately 1 TWh over the past 10 years. Growth of 1 TWh is equivalent to the deployment of approximately 200,000 EVs.

Illustration of Potential Economic Impacts

EVs are anticipated to reach price parity with conventional vehicles by 2025. Elimination of this cost differential may increase EV adoption in the long term. In the near term, government and utility intervention could accelerate EV adoption.

Increased EV adoption would create new demand for electricity that does not exist today. This increase in domestic demand for electricity could offer economic benefit for the province.⁴⁰ The following calculation illustrates potential annual revenue impacts at electricity rates of \$0.17/kWh.

Potential Annual Revenue Impact Of Each Electric Vehicle

Potential EV Revenue
(Avg. annual use x forecasted retail rate)

5,000 kWh X \$0.17/kWh = \$850

Potential Export Revenue
(Avg. annual use x avg. price for exports)

5,000 kWh X \$0.037/kWh = \$185

Potential EV revenue vs. Export revenue
(Potential EV Revenue - Potential Export Revenue)

\$850 - \$185
= \$665

³⁹ A June 2017 project cost update indicates that in the absence of rate mitigation measures, rates for domestic customers on the island will increase to approximately \$0.23/kWh in 2021. Government has indicated that rates may be lower than this forecast. See Government of Newfoundland and Labrador news release September 2018, *Premier Ball Brings PUB Back into Muskrat Falls*.

⁴⁰ Economic impacts will vary depending on future customer electricity rates, which are uncertain at present. See the July 28, 2017 Telegram article which provides "...Premier Dwight Ball said his government's mission is to make sure rates don't go much above 17 cents per kWh when Muskrat Falls is fully online in 2021...". At the time, the all-in residential rate (including the basic customer charge) was approximately 11.7¢/kWh.

Potential domestic electricity sales revenue per EV is estimated to be materially higher than potential revenue from export of this energy. Based on average annual EV energy consumption of 5,000 kWh per unit, and a retail rate of \$0.17/kWh, potential revenue is approximately \$850 for each EV deployed. Alternatively, if this same amount of energy was sold in export markets at the average price of \$0.037/kWh, potential revenue is approximately \$185. As a result, the annual revenue opportunity of using surplus energy for domestic EV load growth instead of selling to export markets is approximately \$665 per EV.⁴¹ The expected life of an EV is approximately 10 years.⁴² If revenues of \$665 per EV are achieved in each year the EV is in service, total revenue over the 10-year life of the vehicle is estimated to be approximately \$5,000 on a present value basis.⁴³

Potential EV Adoption Scenarios

The overall economic impact of accelerated EV adoption varies depending on the level of adoption achieved. On average, there are approximately 35,000 new vehicles sold annually in Newfoundland and Labrador.⁴⁴ This represents the potential market that could purchase an EV instead of a conventional vehicle each year.

While annual EV sales represent only 0.05% of passenger vehicle sales in Newfoundland and Labrador, the potential for EV sales growth can be estimated based on experience in other provinces.⁴⁵ EV sales currently represent 4% of total passenger vehicle sales in BC and QC, and 2.7% in ON.⁴⁶ EV sales represent 0.5% of vehicle sales in the rest of Canada.⁴⁷ Total potential revenue impacts in this province can be assessed based on a range of scenarios reflecting this Canadian experience.

⁴¹ This calculation is a simple illustration of the potential annual revenue from EVs when an electricity rate of \$0.17/kWh is used. The potential annual revenue calculation will change depending on what electricity rate is used as an input into the calculation. For example, if the current electricity rate of approximately \$0.12/kWh was used instead, the potential annual revenue impact would look more like \$415:

Potential EV Revenue (Avg. annual use x current retail rate) 5,000 kWh X \$0.12/kWh = \$600	Potential Export Revenue (Avg. annual use x avg. price for exports) 5,000 kWh X \$0.037/kWh = \$185
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$$\begin{aligned} & \text{Potential EV revenue vs. Export revenue} \\ & (\text{Potential EV Revenue} - \text{Potential Export Revenue}) \\ & \$600 - \$185 \\ & = \$415 \end{aligned}$$

⁴² See Fleetcarma, *The facts about electric vehicles*, August 2018.

⁴³ Present value is a financial calculation that measures the worth of a future amount of money in today's dollars. This considers the annual forecast cash flows of \$665, assuming an annual discount rate of 6% over the 10 year period.

$$PV = \$665 [1 - (1 + 6\%)^{-10} / 6\%] = \$4,894, \text{ or approximately } \$5,000.$$

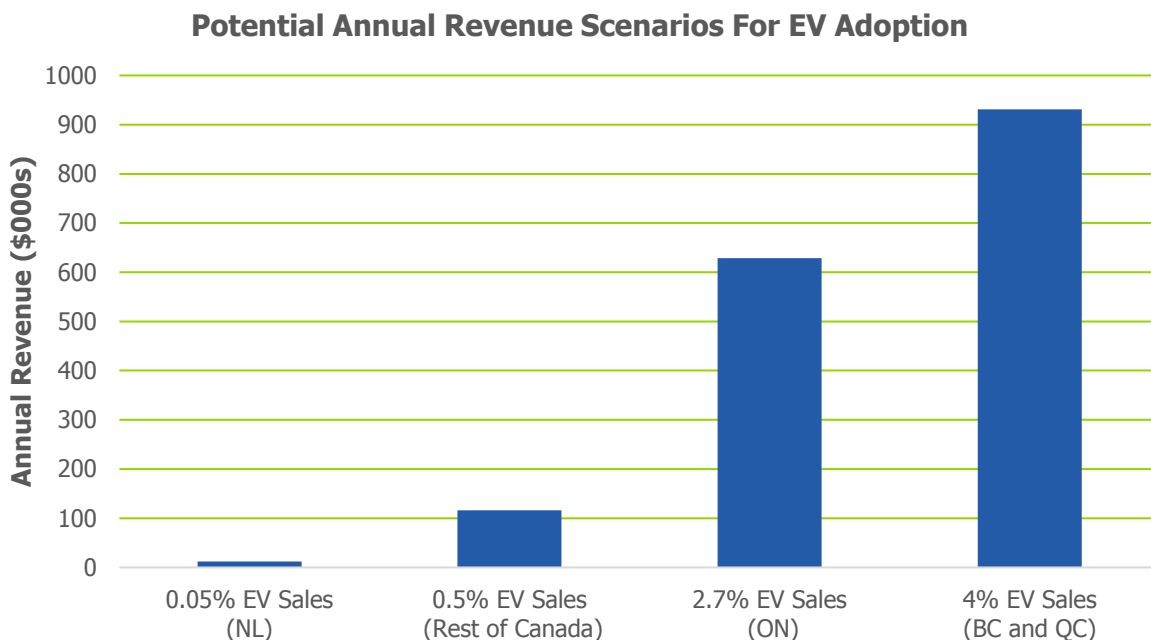
Potential revenue does not include potential utility investments such as distribution system upgrades and supply capacity considerations.

⁴⁴ Data obtained from Statistics Canada, *New Motor Vehicle Sales, by Type of Vehicle*, Table 20-10-0002-01.

⁴⁵ $35,000 * 0.0005 = 18$.

⁴⁶ $35,000 * 0.027 = 945$ and $35,000 * 0.04 = 1,400$.

⁴⁷ $35,000 * 0.005 = 175$.



Depending on which scenario is realized, the potential revenue from annual EV sales could be material. In the Newfoundland and Labrador scenario, annual revenue from the sale of new EVs could reach approximately \$12,000.⁴⁸ Likewise, if sales similar to those to date in Quebec and British Columbia were achieved in Newfoundland and Labrador, annual revenue could reach approximately \$1,000,000.⁴⁹

Benefits to ratepayers under a 4% EV sales scenario could approach approximately \$7 million over a 10 year period.⁵⁰ Although this amount is only an illustration based on a particular set of assumptions, it shows that the potential benefits of EV adoption in Newfoundland and Labrador could be material.

Policy Considerations

Investment is necessary to achieve accelerated EV market growth. Implementation of supportive public policy and infrastructure will require resources and funding. The potential revenue achieved through new EV load growth represents the maximum investment that can be made to stimulate the EV market without impacting customer costs.

Besides electricity sales revenue, there are other sources of funding that could be used to stimulate the EV market. One source is Federal and Provincial government funding that is available through various initiatives.⁵¹ Another option, as previously mentioned, is the provincial carbon pricing plan. Sale of carbon credits in the North American market could be another alternative. A carbon credit is a credit

⁴⁸ \$665 *18 = \$11,970.

⁴⁹ \$665*1,400 = \$931,000.

⁵⁰ 1,400 EVs * \$5,000 NPV per EV = \$7,000,000.

⁵¹ The Federal government has funding available through the NRCan Electric Vehicle and Alternative Fuel Infrastructure Deployment Initiative, and Newfoundland and Canada’s Integrated Bilateral Agreement.

for GHG reductions achieved by one party that can be purchased and used to compensate the emissions of another party. For example, carbon credits representing a reduction of 1 tonne of CO₂ will be available for sale in the United States in 2019. The revenue generated from the sale of carbon credits could be invested to help accelerate EV adoption and expansion of EV charging infrastructure while also reducing emissions.⁵²

Investment in the EV market may be economically attractive for various levels of government, as well as utilities. However, investments do not guarantee adoption. Customer decisions can be constrained by important factors such as higher upfront cost, longer payback periods, lack of product performance information and lack of product availability. The rate at which customers accept and purchase technologies, such as EVs, will be influenced by the combination of financial incentives, information and other measures put in place by the utilities, various levels of government and the private sector to reduce the barriers such as those noted above.

Newfoundland Power, through its existing energy conservation capabilities, has experience in identifying and addressing barriers to the adoption of new customer technologies. This experience includes education, market capacity building and financial incentives, all of which can be applied to advancing the EV market.

Assessment

The global EV Market is expanding rapidly

Countries such as Norway, China and the United States will continue to lead global growth in the future. An aggressive scenario sees the global market maintaining a 30% growth rate, achieving over 13.5 million sales in 2026.

EV growth is dependent on public policy supports

Global leaders in EV market growth have implemented strong public policy support in a variety of forms which have driven growth in these markets. This includes a mix of financial and non-financial measures. Examples include federal and provincial funding for: (i) EV purchase incentives, (ii) public charging infrastructure, particularly supporting long distance travel and (iii) establishment of low and zero-emission vehicle mandates. Current EV penetration in Newfoundland and Labrador is negligible, reflecting the need for public policy and infrastructure supports. These types of supports are necessary in order to make EVs a viable option in Newfoundland and Labrador.

⁵² See S&P Global, *In 'game-changer,' EV charging stations to tap carbon credit market in 2019*, September 2018.

Increased numbers of EVs could assist the province in meeting its GHG emission reduction targets

Passenger cars and light trucks represent over 40% of the province's transportation GHG emissions. As such, EVs offer a significant opportunity to reduce GHG emissions and meet provincial climate change objectives. Revenue generated through a carbon pricing plan could be used to develop the provincial EV market.

Surplus electricity from Muskrat Falls can support the EV market

Surplus electricity of 2 TWh will become available after the implementation of the Muskrat Falls project. This surplus electricity can be used to electrify the transportation industry. This would create economic benefits for the province because more revenue would be generated locally from EVs than would be achieved in the North American export market.

Revenue from EV load growth will benefit electricity customers

Any revenue generated from EVs can be used to offset overall electricity system costs. This would benefit electricity customers by reducing the revenue required to be collected from customers. Revenue generated from EV load growth could be used to mitigate the impact of the costs associated with Muskrat Falls on customers' electricity rates.

Further analysis is required

The impacts of EV adoption on the provincial electrical system must be assessed. Newfoundland Power is uniquely positioned to study the impact on its distribution system. The Company intends to perform a series of modeling exercises to determine the effects of EV loads on its distribution system. The Company will model a number of scenarios based on variances in location, level of charging, EV penetration and distribution load characteristics. This work is expected to be completed in 2019.

Further research is also needed on the appropriate mix of public policy measures and incentives required to increase EV adoption locally. Collaboration between governments and utilities is required to determine what types of investments are needed and evaluate the options for economic and technical feasibility.

Appendix A: Electric Vehicle Technologies

Electric Vehicles

An EV is an alternative fuel vehicle that uses an electric motor for propulsion instead of more common propulsion systems based on gas powered internal combustion engines. EVs contain batteries that store electricity which powers the vehicle's wheels via an electric motor. An EV that travels 20,000 km/year would use approximately the same amount of electricity every year as a typical electric water heater. This equates to approximately \$0.03/km driven compared to a conventional vehicle that costs approximately \$0.10/km driven based on the price of gas.⁵³



There are two major types of EVs:

Battery Electric Vehicle (“BEV”) – this type of vehicle has an engine and is propelled by electricity that comes from one or several high capacity batteries. BEVs are powered by electricity by plugging in to an electrical outlet or specialty Electric Vehicle Charging Equipment (“EVCE”).

Plug-in Hybrid Electric Vehicle (“PHEV”) – this type of vehicle combines a gasoline or diesel engine with an electric motor and a rechargeable battery. Modern PHEVs can be driven in electric mode over varying distances before the combustion engine is required. Unlike earlier hybrids that use gasoline as their main power source, PHEVs can be plugged-in and recharged from an outlet, allowing them to drive extended distances using only electricity.

Refuel or Recharge

Vehicle Type	Gasoline	Electricity
Gas Only	X	
PHEV	X	X
BEV		X

⁵³ Gasoline rate of \$1.38/litre approved by the PUB on July 19, 2018.

The primary difference between a BEV and a PHEV is the driving range. A BEV's driving range is limited by the storage capacity of its battery and availability of charging infrastructure. A PHEV is equipped with a fuel tank and an internal combustion engine which allows for an increased driving range.⁵⁴

EV efficiency is measured in kwh/km. EVs convert about 59%–62% of the electrical energy to power that allows the vehicle to operate. Conventional gasoline vehicles only convert about 17%–21% of the energy in gasoline to power the vehicle.⁵⁵

The battery system in an EV is the key technology as it defines its range and performance characteristics. EV batteries are designed to last approximately 12 to 15 years in moderate climates and 8 to 12 years in severe climates.⁵⁶ The price of EV batteries has dropped by 80% between 2010 and 2016, and is predicted to continue to decrease over the next 7 years.⁵⁷

EV batteries can typically charge up to 80% of its capacity fairly quickly. Using a Level 3 charger, they can charge up to 80% in approximately 30 minutes.⁵⁸

Hybrid vs. PHEV

The difference between a conventional Hybrid and PHEV:

Hybrid	PHEV
Gasoline is the main power source	Electricity is the main power source
Electricity is generated by regenerative braking	Electricity is supplied from the grid
Minimal fuel savings	Substantial fuel savings

EV Range

The distance an EV can travel depends on:

- Whether it's a BEV or PHEV
- battery capacity
- weight carried
- temperature
- accessories
- driving style

⁵⁴ See Environmental Protection Agency, *Explaining electric & plug-in hybrids electric vehicles*.

⁵⁵ See U.S. Department of Energy, *All electric vehicles*.

⁵⁶ See U.S. Department of Energy, *Electric vehicle benefits and considerations*.

⁵⁷ See Electrek, *Electric vehicle battery cost dropped 80% in 6 years down to \$227/kWh*, January 2017.

⁵⁸ See Fleetcarma, *A simple guide to electric vehicle charging*, August 2016.

Electric Vehicle Charging Equipment

Currently, there are over 3,500 public charging stations in Canada and that number continues to grow.⁵⁹ Charging stations can be found in a variety of places, including shopping malls, restaurants, office buildings, etc.

Level 1 Chargers

Level 1 chargers are most commonly used in residential applications and have the longest charging time. Typically, EV owners would charge their vehicle overnight. These chargers are compatible with common 120 volt outlet found in garages, parking lots, and exteriors of homes.

Level 2 Chargers

Level 2 chargers provide a faster charge. They are typically used in public or workplace parking areas but some are used for residential applications. This type of charger installation is typically more complicated and more expensive than Level 1, as it requires considerable electrical and construction work. The majority of EV models sold in North America use the same charging standard and can use any Level 2 station across Canada and the United States.

Level 3 Chargers

Level 3 chargers, or fast chargers, have the highest power demands of 40-100 kW and a faster charging time of 0.5-1 hour to fully charge. They are also the most expensive EVCE to install.

The development and proliferation of EVs must be accompanied by EVCE. Table A-1 shows the types and the costs per level of EVCE.

Charging at home with a Level 1 charger is the most common way of charging an EV. It is also the least expensive alternative of the 3 EVCEs. It is likely the most convenient alternative as well, as it does not require the EV driver to plan around the availability of public EVCE or wait in line to charge their vehicle. The Level 1 EVCE is also the slowest charge. Level 2 and Level 3 EVCE can charge a vehicle in a fraction of the time, but installation costs are often prohibitive for EV drivers, business owners and even municipalities.



Level 2 Charger



Level 3 Charger

⁵⁹ See Natural Resources Canada, *Electric charging and alternative fuelling stations locator*, September 2018.

**Table A-1
EV Charger Types**

Type of Charger	EVs Supported	Current Type	Typical Voltage (V)	Average Charge Time (hours)	Demand (kW)	Max Range per hour of charge (km)	Common Installation	Cost (\$)
Level 1	All	AC	120 ⁶⁰	8-20 ⁶¹	1-2 ⁶⁰	8 ⁶⁵	Residential	0 - 2,300 ⁶²
Level 2	All	AC	240 ⁶⁰	3 – 8 ⁶¹	3.3-19.2 ⁶³	35-48 ⁶⁵	Residential, Public or workplace	1,700 - 16,000 ⁶²
Level 3	BEVs	DC	480 ⁶⁴	0.5-1 ⁶⁵	50-350 ⁶⁶	240 ⁶⁵	Commercial or Highways	100,000 - 125,000 ⁶⁷

⁶⁰ See Esource, *EV charging technology and trends can guide utility strategy*, November 2015.

⁶¹ See ChargeHub, *Guide on charging your electric vehicle at home*, 2019.

⁶² See Realtor.com, *Electric Car charger installation in your home*. November 2017.

⁶³ See Inside EVs, *Electric Vehicle charging Levels Explained*, November 2015.

⁶⁴ See Ontario Ministry of Transportation, *Charging electric vehicles*, July 2018.

⁶⁵ See eMotorWerks, *how long does it really take to charge and electric car*.

⁶⁶ See EV Obsession, *Electric Car Charging 101 — Types Of Charging, Charging Networks, Apps, & More!*, September 2015.

⁶⁷ See Avista Corporation, Docket UE-160082, March 10, 2016.

Appendix B: Canadian Regulatory Experience

There is currently no standard practice for the regulatory treatment of EV utility investment in Canada. In British Columbia and Ontario, the regulator has approved limited utility investment in EV infrastructure. In other jurisdictions, including Nova Scotia and New Brunswick, the regulator has denied utility applications for similar investments. In these cases, the utility proceeded with EV infrastructure investments outside of their regulated activities.

FortisBC Inc. applied to the British Columbia Utilities Commission (BCUC) in 2017 for approval of rate design and rates for EV level 3 fast charging stations. The BCUC established an inquiry into the regulation of EV charging stations in January 2018.⁶⁸ A rate of \$9 per half hour of level 3 charging was approved on an interim basis. This inquiry will consider: (i) whether EV charging infrastructure should operate in a competitive or monopoly environment, (ii) whether and why the BCUC should regulate EV charging, (iii) rate design for EV charging (i.e. cost of service or utility wholesale rate), (iv) the appropriateness of including EV charging infrastructure in utility rate base, and (iv) the risk of cross subsidization if EV charging infrastructure is included in regulated business.⁶⁹

Intervenors submitted arguments which identified a number of considerations including the BCUC's jurisdiction to regulate 3rd party EV charging stations; role of public utilities in providing EV charging services; the inclusion of EV charging stations in rate base; and how the BCUC could determine the degree to which government policies should guide public utility investments. The inquiry will proceed in 3 phases. The first phase of the Inquiry will address the following: (i) do the words "for compensation" in the definition of public utility mean that a person who does not expressly require customers to pay for charging services but instead recovers the cost of charging from other services provided to the customers is a "public utility"; (ii) should entities not otherwise public utilities supplying electricity to EV end users be regulated at all; and (iii) where public utilities participate in the EV market as owners or operators of EV charging stations, clarity is needed on whether public utilities are permitted to invest in EV charging stations.⁷⁰

The regulatory treatment of the EV market has been different in Ontario than the rest of Canada. The Ontario Energy Board ("OEB") has acknowledged the importance of EV adoption in reducing GHG emissions and meeting the province's climate change goals. Further, the OEB has recognized that there are utility challenges that will need to be addressed to enable increased penetration of EVs. The OEB determined that, similar to other conservation and demand management activities, the costs associated with an EV market deployment programs could be eligible for recovery through rates. The

⁶⁸ In 2012, the BCUC established principles regarding the provision of products and services outside of traditional utility activities. The BCUC determined that regulation was appropriate only where necessary and should not impede competitive markets.

⁶⁹ See BCUC Order Number G-119-18.

⁷⁰ See BCUC Order G-119-18, Appendix A.

OEB is currently conducting research to examine and identify steps for pursuing cost-effective opportunities for utilities to facilitate access to residential smart charging for EVs.⁷¹

NB Power has established a network of charging stations to allow EV drivers to travel around the province. In its 2018/2019 general rate case, NB Power applied to the New Brunswick Energy and Utilities Board ("EUB") for \$1.3 million to fund EV charging infrastructure. The EUB determined that EV charging stations are not within the core business of NB Power. Such stations are currently provided by the private sector, without any ratepayer investment. The Board disallowed the budgeted amount of \$1.3 million.⁷²

Nova Scotia Power (NS Power) submitted a request to the Nova Scotia Utility and Review Board ("UARB") in 2017 for approval of a \$420,000 Electric Vehicle Charging Station Network Pilot Project. The project proposed the purchase and installation of 12 charging stations at third party locations to understand the impacts on the electrical system. The UARB acknowledged the value of EV charging stations, but found that the evidence did not support the need for NS Power to be the owner of the EV charging stations to accomplish the declared purpose of the project. The UARB concluded that NS Power's application was not in the best interest of ratepayers and denied the application.⁷³ Despite this outcome, NS Power proceeded with the installation of the fast charging stations through a cost sharing arrangement with Natural Resources Canada.

⁷¹ See The Ontario Energy Board's Implementation Plan in response to the Minister of Energy's directive in respect of the implementation of *Ontario's Long Term Energy Plan 2017: Delivering Fairness and Choice*.

⁷² See New Brunswick Energy and Utilities Board Decision (Matter No.375), July 20, 2018.

⁷³ See Nova Scotia Utilities and Review Board Decision 2018 NSUARB 1 M08224, January 4, 2018.

Appendix C: Canadian EV Incentive Programs

British Columbia

- The Government of British Columbia offers a rebate of up to \$5,000 for the purchase of an electric vehicle and \$2,500 for the purchase of a rechargeable hybrid vehicle.⁷⁴
- The SCRAP-IT Program offers a rebate of up to \$6,000 when you scrap an old gas-fuelled vehicle and replace it with a new or used electric vehicle.⁷⁵
- Plug In BC's Residential Building Incentive provides funding for the purchase and installation of one or multiple Level 2 charging stations in multi-unit residential buildings with 3 units or more. The program covers 75% of total project costs up to \$4,000 per station.⁷⁶
- Plug In BC's Workplace Charging Incentive provides companies and building owners or managers with funding to support the installation of workplace charging infrastructure. The program covers 50% of total project costs, up to \$4,000 per Level 2 station.⁷⁷

Quebec

- The Quebec government has set a goal of having 100,000 electric or hybrid vehicles on provincial roads by 2020, and one million by 2030, similar to the ZEV policy in the US. The target is part of Quebec's plan to reduce GHG emissions by 37.5% below 1990 levels by 2030.⁷⁸
- Through the Drive Electric Program, the Québec government offers a rebate of up to \$8,000 when you buy or lease a new electric vehicle. The discount is available to individuals, businesses, organizations and municipalities.⁷⁹
- The Quebec government also offers financial assistance of \$350 for the purchase of a level 2 residential charging station and \$250 for its installation and electrical supply infrastructure by a licensed electrician, for a total of \$600.⁸⁰
- A number of municipalities offer additional rebates.⁸¹
 - The City of Sherbrooke offers financial assistance of up to \$500 for the purchase and installation of a residential charging station.
 - The City of Joliette offers financial assistance for the purchase and installation of a residential charging station. The rebate covers 25% of the total costs, up to \$250.

⁷⁴ See Clean Energy Vehicles for British Columbia, *Clean Energy Vehicle Program*, <https://www.cevforbc.ca/clean-energy-vehicle-program>

⁷⁵ See Scrap-it, <https://scrapit.ca/>

⁷⁶ See Plug In BC, *Residential Building Charging Incentive*, <https://pluginbc.ca/residential-building-charging-incentive/> March 2016.

⁷⁷ See Plug In BC, *Charging solutions & incentives*, <https://pluginbc.ca/incentives/charging-solutions-incentives/>

⁷⁸ See Quebec's Commitments, *Our GHG emission reduction targets*, <http://www.environnement.gouv.qc.ca/changementsclimatiques/engagement-quebec-en.asp>

⁷⁹ See Transportation Electrification Action Plan, *Purchase or lease program* <http://vehiculeselectriques.gouv.qc.ca/english/particuliers/rabais.asp>

⁸⁰ See Transportation Electrification Action Plan, *Charging Station Rebate* <http://vehiculeselectriques.gouv.qc.ca/english/particuliers/remboursement.asp>

⁸¹ See Flo, *Rebates and incentives for EV drivers in Canada* <https://flo.ca/at-home/rebates-incentives>

- The City of Granby offers a rebate covering 25% of the purchase and installation costs of a residential charging station for electric vehicle, up to \$250 per station.
- The City of Prévost offers a rebate of \$100 to its residents for the purchase and installation of a residential charging station for electric vehicle.
- CAA-Québec gives back 100 CAA Dollars on the purchase of a home charging station.⁸²
- The Branché au travail program offers a 50% rebate for the purchase and installation of charging stations at workplaces, up to \$5,000 per charging station.⁸³

Ontario

Ontario's EV incentive programs ended in September 2018.

- The Electric Vehicle Incentive Program provides individuals, businesses, and organizations that purchase or lease a new plug-in hybrid EV or battery EV with a rebate of up to \$14,000:
 - Vehicles with a battery capacity from 5 to 16 kWh are eligible for incentives ranging between \$6,000 to \$10,000 based upon the battery size of the vehicle;
 - Vehicles with a battery capacity of larger than 16 kWh are also eligible for an additional \$3,000 incentive;
 - Vehicles with five or more seats are also eligible for an additional \$1,000 incentive;
 - PHEVs with an Manufacturer's Suggested Retail Price ("MSRP") of \$75,000 to \$150,000 are eligible for a maximum incentive value of \$3,000;
 - BEVs and PHEVs with an MSRP of \$150,000 or greater are not eligible for an incentive; and
 - Vehicles with a 12 month lease term will receive 33% of the incentive, 24 month lease term receives 66% of the incentive and leased vehicles with a 36 month or longer term will receive the full incentive.⁸⁴
- The Ontario Ministry of Energy is undertaking an electric school bus pilot program funded by the province's Climate Change Action Plan.⁸⁵ The purpose of the pilot is to determine whether electric school buses ("ESBs") can operate reliably and cost effectively in all weather conditions.
- The ESB pilot provides funding up to \$400,000 for the purchase of an ESB as well as Level 2 chargers in a minimum of 5 municipalities.
 - The pilot will begin in March 2018 with a final report is due in March 2019 which will determine the role of ESBs in the future, if any.

⁸² See Canadian Automotive Association, *Flo*, <https://www.caaquebec.com/en/caa-dollars-and-discounts/find-discounts/flo/>

⁸³ See Flo, *EV charging incentives programs for business*, <https://flo.ca/business/incentive-programs>

⁸⁴ See Ontario Ministry of Transportation, *About electric and hydrogen vehicles*, <http://www.mto.gov.on.ca/english/vehicles/electric/about-electric-vehicle.shtml> July 2018.

⁸⁵ See Grants Ontario, *Electric School Bus Pilot Program program guide*, August 2017.

Results from the 2018 takeCHARGE Marketing Survey

Results from the 2018 takeCHARGE Marketing Survey

Results from the 2018 takeCHARGE Marketing Survey

Table 1 shows the probability of survey respondents purchasing an electric vehicle and Table 2 shows the barriers identified by survey respondents to purchasing an electric vehicle.

Table 1:
How likely are you to consider buying an electric vehicle in the next 5 years?

Total Respondents	510
Very likely	5%
Somewhat likely	12%
Not very likely	30%
Not at all likely	51%
Don't know	3%

Table 2:
Why are you unlikely to consider buying an electric vehicle?¹

Total Respondents	412
Cost to purchase	27%
Not planning to purchase a new vehicle in the foreseeable future / recently purchased new vehicle	23%
Availability of charging stations	15%
Not suitable / available for lifestyle (age, family size, employment requirements, style of vehicle, climate, etc.)	11%
Not interested / doesn't like them / doesn't need one (general)	10%
Doesn't know enough about them / they are still too new to the market	8%
Doesn't drive / uses public transportation	7%
Concerned about reliability / charge range / running out of power / engine performance (long distance travel)	7%
Doesn't know	5%
Cost of electricity	3%
Miscellaneous	3%
Have never considered it	1%
Would prefer / used to using a gas powered vehicle	1%
Cost (general)	1%

¹ Question posed only to respondents who indicated they were not very likely or not at all likely to buy an electric vehicle.