



P.O. Box 1749
Halifax, Nova Scotia
B3J 3A5 Canada

Item No. 12.1.1
Environment and Sustainability Standing Committee
November 4, 2021

TO: Chair and Members of Environment and Sustainability Standing Committee

Original Signed

SUBMITTED BY:

Kelly Denty, Executive Director, Planning and Development

Original Signed

Jacques Dubé, Chief Administrative Officer

DATE: August 10, 2021

SUBJECT: Municipal Electric Vehicle Strategy

ORIGIN

September 19, 2019 Halifax Regional Council passed the following motion:

“That Halifax Regional Council direct the Chief Administrative Officer to:

1. *Report back to Environment and Sustainability Standing Committee with both an electric vehicle infrastructure strategy and light-duty fleet strategy, complete with budgetary considerations to:*
 - a. *Install and administer public electric vehicle charging infrastructure at new and existing Municipal facilities, rights of way and/or public parking sites including rural fire stations with backup generators and park and ride terminal locations; and*
 - b. *Convert a portion of the municipal fleet to electric vehicles and install charging stations at municipal facilities.*
2. *Return to Council with recommendations for specific legislative amendments to enable the Municipality to require necessary zero emission vehicle infrastructure in new developments.”*

June 23, 2020

Halifax Regional Council adoption of HalifACT

RECOMMENDATIONS ON PAGE 2

LEGISLATIVE AUTHORITY

Halifax Regional Municipality Charter, 2008 SNS c 39:

- 7A The purposes of the Municipality are to
- (a) provide good government;
 - (b) provide services, facilities and other things that, in the opinion of the Council, are necessary or desirable for all or part of the Municipality;
 - (c) develop and maintain safe and viable communities.
- 79A (1) Subject to subsections (2) to (4), the Municipality may only spend money for municipal purposes if:
- (a) the expenditure is included in the Municipality's operating budget or capital budget or is otherwise authorized by the Municipality;

34(3) The Council shall provide direction on the administration, plans, policies, and programs of the Municipality to the Chief Administrative Officer.

61(3) The property vested in the Municipality, absolutely or in trust, is under the exclusive management and control of the Council, unless an Act of the Legislature provides otherwise.

Building Code Act

4 (1) The Minister may make such regulations as are considered necessary or advisable for the purpose of establishing a Building Code governing minimum standards for the construction and demolition of buildings ...

4(2) Upon the recommendation of the council of a municipality, the Minister may, by regulation, prescribe additional standards applicable to the construction or demolition of buildings in that municipality, where such standards are more stringent than the standards in the Building Code or relate to matters not regulated by the Building Code.

RECOMMENDATION

It is recommended that the Environment and Sustainability Standing Committee recommend that Halifax Regional Council:

1. Adopt the Halifax Regional Municipality Electric Vehicle Strategy as set out in Attachment 1 of this report;
2. Recommend that the Minister of Municipal Affairs and Housing prescribe additional standards by regulation of the *Building Code Act* to require "EV Ready" parking stalls for the construction of new buildings within the Halifax Regional Municipality and request the Mayor write a letter to the Minister requesting these regulations; and
3. Request the Mayor write a letter to the Premier of Nova Scotia requesting that the Zero Emission Vehicle mandate, introduced in the *Environmental Goals and Climate Change Reduction Act*, be strengthened to better align with HalifACT.

BACKGROUND

HalifACT: Acting on Climate Together is the Municipality's long-term climate action plan to reduce emissions and help communities adapt to a changing climate. The Plan¹ aligns with the Climate Emergency that was declared by Halifax Regional Council on January 29, 2019, which emphasized that climate change is a serious and urgent threat to our community. The Plan was unanimously approved by Halifax Regional Council in June of 2020 and outlines a suite of actions that are necessary to meet the significant carbon reductions outlined in the plan. As part of Council's approval, staff was directed to prioritize efforts in seven critical core areas, one being to **develop a municipal electric vehicle strategy** that would guide a low carbon transportation transition. Through a competitive process, Dunskey Energy Consulting was hired in spring 2020 to develop this electric vehicle strategy that provides recommendations relating to public infrastructure, policy requirements, education needs and a municipal light duty fleet transition plan to position Halifax as an EV-ready municipality.

DISCUSSION

In 2016, the transport sector contributed to 20% of overall community emissions, with light duty cars and trucks making up 90% of the total. While HalifACT first recommends a transition to public transit or active transportation, it also recommends that the Municipality take significant action to accelerate the transition to electric vehicles (EVs). The Halifax Regional Municipality Electric Vehicle Strategy in Attachment 1, referred to throughout this report as the Strategy, lists the direct and indirect strategic actions required to accelerate the EV transition.

As mentioned above, the Strategy was developed by Dunskey Energy Consulting with direction from the Municipality. To develop the Strategy, Dunskey leveraged their expertise in clean mobility, their proprietary modeling software, reviewed EV strategies in other jurisdictions, and conducted stakeholder engagement. The stakeholder engagement consisted of Municipal staff, leaders in the sector and interested community members. This engagement was conducted to develop partnerships and ensure the recommended actions were feasible.

The final Strategy includes four key areas of focus:

Public Charging Infrastructure: this section includes a detailed plan of the number of chargers needed within the Halifax region, specific recommendations on geographical locations, and overall cost estimates.

Electric Vehicle Policies: this section includes specific recommendations on municipal and provincial policies that can help increase access to home charging which will alleviate a significant barrier to EV adoption.

Advocacy and Support: this section covers critical actions that are outside of the Municipality's direct control but for which it can advocate for, as well as educational partnerships.

Light Duty Fleet Electrification: this section provides the Municipality with a roadmap for electrifying its light duty fleet to achieve its 100% EV target in the most cost effective and the least disruptive way.

Full technical details of each area of focus are covered in the Strategy.

¹ HalifACT – Acting on Climate Together, Halifax Regional Council Package <https://www.halifax.ca/sites/default/files/documents/city-hall/regional-council/200623rc916.pdf>

Public Charging Infrastructure

One of the most common barriers to EV adoption is range anxiety brought on by the lack of public charging infrastructure. Range anxiety refers to the concern that the vehicles battery will run out before finding a charging site. While most charging (approximately 80%) is typically done overnight at home, public infrastructure can ease this anxiety, provide an alternative to those without at-home charging and signal to the consumer that investments are being made to support the transition.

In recent years, Nova Scotia Power Inc. (NSPI) has led investments in public charging along provincial highways, however there is no clear mandate for them to continue this work, nor is there a defined leader in the space. There are currently only three public Direct Current Fast Charging (DCFC) and 40 level 2 (L2) ports in the municipality. Dunsky's EV Adoption Model, which looks at the current baseline of charging infrastructure, the average driving distance of residents and the number of multi-use residential dense areas, recommends that 100 DCFC ports and 1,000 L2 ports be installed within the next ten years to help accelerate the transition to EVs.

DCFCs provide the fastest charge to EV owners. Depending on the electrical capacity of the charger, an EV owner can expect an 80% charge in 20-60 minutes. Due to this high rate of charge, DCFCs are typically installed along highway corridors and alongside amenities within dense multi-use residential areas. This offers EV owners a similar experience to traditional re-fueling, should they be covering long distances or not have access to at home charging.

L2 charging sites provide a slower charge to EV owners at a rate of about 40 kilometres per hour or a full charge in about 8 hours. Due to this slower charge, they are typically installed at homes, workplaces, on-street in dense residential areas and public parking lots where EV owners are parked for several hours, overnight or simply require a top up.

While it is anticipated that the utility and private investors will support public charging deployment as the adoption of EVs increase across the province, the Municipality has the responsibility to lead in the short term. This aligns with other leading jurisdictions like Toronto, Victoria and Montreal, who have already deployed or have plans to deploy public charging within their communities.

The Strategy recommends that charging sites be deployed in **two phases** as outlined in figure 1.

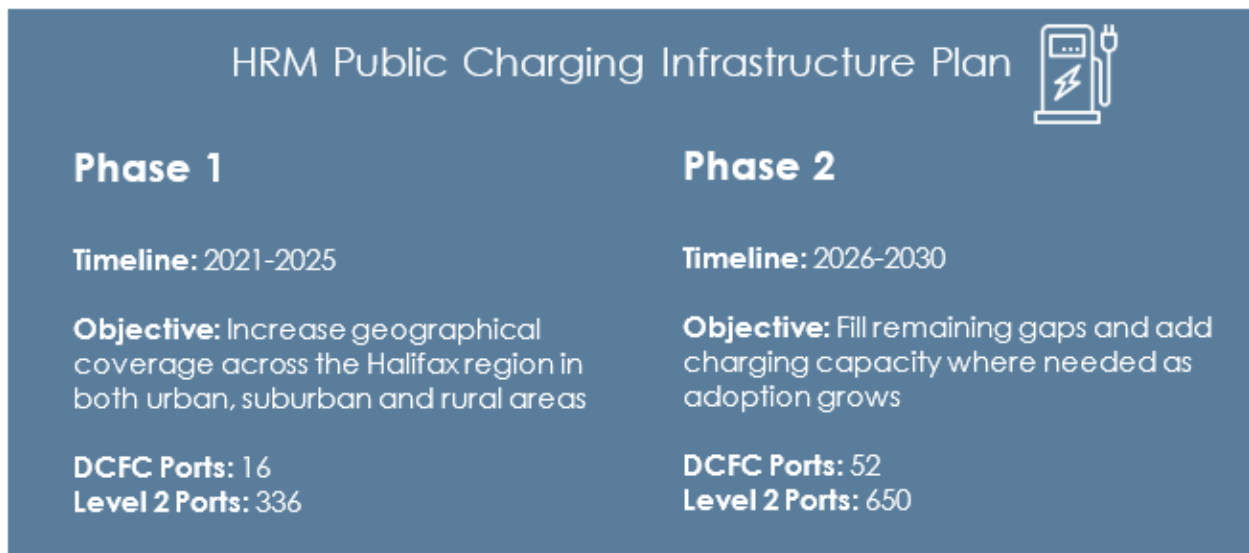


Figure 1: HRM public charging infrastructure plan

In Phase 1, it is recommended that charging sites be installed along highways to close the gap for rural communities and off-street within the urban core. This will play a more critical role than on-street charging in early adoption. Phase 1 has a lower installation rate than Phase 2 to account for a ramp up in EV adoption, to allow time for monitoring and assessment and to develop partnerships for more private investment, as the Municipality only has authority to place charging sites on Municipally owned land. Charging sites along highways and off-street, as recommended in the Strategy, will need to be deployed by the private sector, or other levels of government.

To increase coverage across the region and initiate Phase 1, an application has been submitted to Natural Resources Canada’s (NRCan) Zero Emission Vehicle Infrastructure Program² (ZEVIP). NRCan’s ZEVIP offers eligible organizations funding to install electric vehicle chargers in public places, workplaces, municipal fleet depots and multi-unit residential buildings. The fund covers 50% of eligible costs up to a maximum of \$5 million. Eligible costs include infrastructure, installation and salaries of staff coordinating the project. In partnership with Facility Design and Construction and after consultation with NSPI, the following locations have been considered:

Table 1: Charging locations considered through ZEVIP

Site	Community	L2 Ports	DCFC Ports
Zatzman Sportsplex	Dartmouth	20	1
Kiwanis Grahams Grove Park	Dartmouth	4	0
RBC Centre	Burnside	12	0
J.D. Shatford Memorial Public Library	Hubbards	0	1
Musquodoboit Harbour Public Library	Musquodoboit Harbour	0	1
Fire Station 38	Middle Musquodoboit	0	1
Cole Harbour Place	Cole Harbour	20	1
Sackville Sports Stadium	Lower Sackville	20	0
New Sheet Harbour Recreation Centre	Sheet Harbour	0	1
Keshen Goodman Public Library	Halifax	10	1
St. Margaret’s Centre	Upper Tantallon	20	1
Sackville Public Library	Lower Sackville	0	1

A total of \$1 million is being requested through ZEVIP, with matching funds available in the 2021/22 Climate Change Capital Account, CB200012. A funding decision should be made by December 2021 and if successful, applicants will have 30 months to install and commission the sites. The first site is not expected to be operational until the start of the 2022/23 fiscal year. Future areas to be considered are outlined in figures 2 and 3 below. The total cost of the Public Deployment Plan is \$23,000,000 as summarized in Appendix C of the Strategy. Again, this cost will not be borne solely by the Municipality as HRM will work to develop partnerships, secure funding, and encourage private investment.

² Zero-Emission Vehicle Infrastructure Program (ZEVIP). <https://www.nrcan.gc.ca/energy-efficiency/transportation-alternative-fuels/zero-emission-vehicle-infrastructure-program/21876>

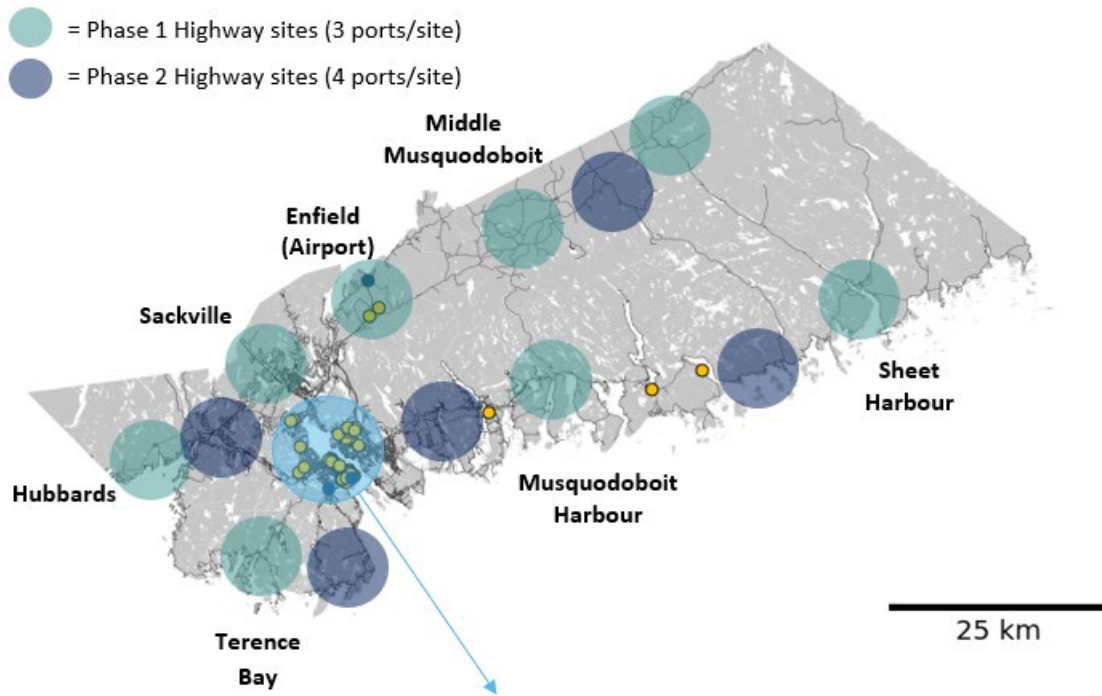


Figure 2: Recommended DCFC install locations along highway corridors

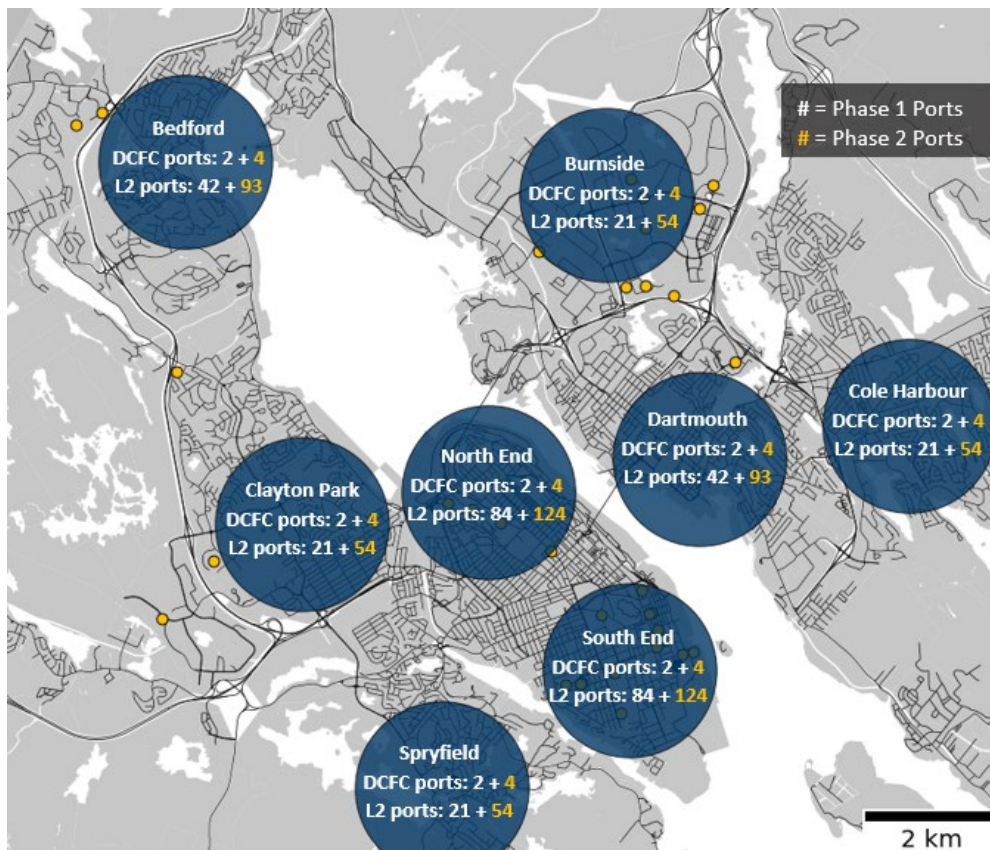


Figure 3: Recommended DCFC and L2 install locations within the urban core

Aside from capital costs, ongoing operational costs need to be considered. Operational costs will include an annual service agreement fee paid to the charger manufacturer for administration, payment collection, monitoring and maintenance along with electricity costs. It is expected that the service agreement will be approximately \$150 per L2 port and \$1,500 per DCFC annually. Currently, there is no set tariff for EV charging so the annual electricity costs will depend on the location of the charging site, the grid connection configuration (existing service or new) and the annual usage. Without a specific tariff, predicting the annual operating costs can be difficult, especially if annual consumption is high enough to introduce demand charges. These unknown demand charges can be a key barrier to both public and private deployment. To better predict and strengthen the business case for both public and private charger operators, municipal staff will continue to engage NSPI towards the development of a specific tariff.

In the meantime, all municipally-owned charging sites will be designed to minimize demand charges. To offset annual operating and maintenance costs, fees will be collected from users of the sites. This fee (or fees) and the enforcement mechanism are still being determined in consultation with Legal and Legislative Services and will be presented to Halifax Regional Council for consideration. The fees will be set to try and cover the annual operating costs. Looking to other site operators in the province, fees are initially being considered at \$1.50 per hour of charging for L2 ports and \$15 per hour for DCFC sites, pro-rated by minute. With these fees and the sites listed above, estimated annual operating costs with a maturing market (10% utilization in years 1-3 increasing to 30% in year 4) are presented in table 2. To cover operating costs, the required utilization rate depends on the charging configuration. For a single, 50kW DCFC, the utilization rate must be more than 2% to cover operating costs. For a 20 port L2 site, the utilization must be between 4 and 8% or more than 17% to break even. Due to the introduction of demand charges, utilization rates of between 9 and 16% will result in a net loss of a maximum of \$5,000 annually.

Table 2: Summary of estimated operating costs

Operating	Year 1 2022/23	Year 2 2023/24	Year 3 2024/25	Year 4 2025/26
Gross	\$8,500	\$60,000	\$140,000	\$335,000

In each year, the operating costs increase as more charging ports are added. It is recommended that these operating costs be considered by Council in the budget years identified. These operating costs will be refined as the sites begin to operate and annual usage data becomes available. At the estimated usage rates, it is anticipated that most or all of the annual operating costs will be offset.

Electric Vehicle Policies & Programs

The increase of public charging will ease range anxiety and signal to the consumer that investments are being made to support the transition to EVs. This, however, does not solve the barrier to accessing charging at home, the primary charging method for most consumers. Approximately 10% of municipal residents currently live in multi-use residential buildings (MURBs) without access to overnight charging. With the passing of the Centre Plan, more density is expected within the urban core, and without dedicated overnight charging, it will be difficult for the mainstream consumer to see EVs as a desirable alternative to gas vehicle ownership. While the adoption levels of EVs are low today, it is likely that any newly constructed building will see a 100% EV penetration within its lifetime. Therefore, the Strategy recommends that all newly constructed residential and non-residential buildings be future-proofed for EV charging.

Future proofing buildings for EV charging ensures that parking stalls are “EV Ready”. This means that all required electrical components are in place (wires, breakers, conduit etc.) except for the physical charger. This makes adding the charger, when needed, straightforward and without invasive and costly electrical

retrofits. The Residential Electric Vehicle Charging Guide for Local Governments³, published by the City of Richmond, estimates that the upfront cost of “EV Ready” parking stalls during construction is nearly half the cost of retrofitting after the building is constructed.

As it would be inconsistent with the *Building Code Act*, the Halifax Regional Municipality cannot mandate the inclusion “EV Ready” parking stalls for new construction. Through S 4(2) of the *Building Code Act*, the council of a municipality may recommend that the Minister prescribe additional standards applicable to the construction of buildings in that municipality. Therefore, to help ensure future and current EV owners have access to home charging, it is recommended that the Mayor write a letter to the Minister of Municipal Affairs and Housing requesting specific authority to mandate “EV Ready” parking stalls for new construction within the Halifax Regional Municipality. Specifically, the request would be to require 100% of parking stalls in new residential buildings (multi-unit and single unit dwellings) and 20% of parking stalls for non-residential buildings be “EV Ready”. This request would align with the Municipal Electric Vehicle Strategy, HalifACT and Council’s Strategic Priority of Environment.⁴

As mentioned above, retrofitting an existing building for EV charging can be costly and invasive. To support building owners with this transition, the Strategy recommends that the Municipality include EV charging infrastructure as an eligible measure in a future financing program and act as a delivery agent to provide funding through NRCan’s ZEVIP program and other future funding sources. Staff will consider including EV infrastructure as an eligible measure in the Retrofit, Renewables and Resilient program, currently under development, which aims to achieve the building emission reduction targets of HalifACT. Staff will engage with Procurement and Legal Services to determine if HRM can act as a Third-Party Delivery Agent through ZEVIP. If so, an application will be submitted during the next intake round.

Education, Advocacy & Legislation

In addition to the initiatives above, the Municipality can play a role in educating the public on the benefits of EVs and addressing common misconceptions. The Strategy recommends partnering with existing public education initiatives and strengthening these offerings through in-kind staff time and our outreach networks. In spring 2021, the Municipality partnered with the Clean Foundations Next Ride⁵ program to support their EV test drive events through offering municipally-owned parking lots free of charge. On July 11th, following all COVID-19 protocols, the Municipality co-hosted *Charged Up* with the Clean Foundation at the RBC Centre in Burnside. On October 3rd, Halifax co-hosted Electric Avenue at the Canada Games Centre.

Even with public charging, supportive policies, and education, achieving the HalifACT target of 100% new vehicles sales being EV by 2030 is not possible without a Zero Emission Vehicle (ZEV) mandate. A ZEV mandate sets mandatory EV sales targets for automakers, ensuring a robust supply for consumers at dealerships. Currently, only 1 in 10 dealerships in Nova Scotia have a single EV in stock. This supply shortage is exacerbated as other jurisdictions implement a ZEV mandate and automakers prioritize those markets.

On June 29, 2021, the Government of Canada announced a federal ZEV mandate, requiring 100% of car and passenger truck sales be zero-emission by 2035⁶. This mandate aligns with both Quebec and California, leading North American jurisdictions. On October 27th, 2021, the *Environmental Goals and Climate Change Reduction Act*⁷ was introduced. Within this Act is a commitment to develop and implement a ZEV mandate that ensures, at a minimum, that 30% of new vehicle sales of all light-duty and personal

³ Residential Electric Vehicle Charging: A Guide for Local Governments.

https://www.richmond.ca/_shared/assets/Residential_EV_Charging_Local_Government_Guide51732.pdf

⁴ The Electric Vehicle Strategy recommends HRM charter amendments to enable EV Ready parking stalls however this is in error and will be revised to reflect the recommendation contained within this report.

⁵ Next Ride NS. <https://nextridens.com/>

⁶ Transport Canada, news release. https://www.canada.ca/en/transport-canada/news/2021/06/building-a-green-economy-government-of-canada-to-require-100-of-car-and-passenger-truck-sales-be-zero-emission-by-2035-in-canada.html?fbclid=IwAR1Hq2ivMykQl3gS48h4ah39cmScc_fmzYBJ2MeIri2mbDmOXB4CUCRXIj

⁷ Bill NO. 57, Nova Scotia Legislature, https://nslegislature.ca/legc/bills/64th_1st/1st_read/b057.htm

vehicles in the Province will be zero emission vehicles by 2030. This target is a great step forward to decarbonizing transportation within the Province, however it does not align with the target of HalifACT. Therefore, it is recommended that, should the Act pass as drafted, the Mayor write a letter to the Premier of Nova Scotia requesting that the Provincial ZEV mandate be strengthened to better align with HalifACT. While the Province has not yet defined light-duty and personal vehicles, HRM defines light-duty vehicles as trucks, cars, vans and SUVs weighing under 4,500 kilograms.

Municipal Light Duty Fleet Electrification

A provincial ZEV mandate would aid in the success of Council's HalifACT motion to establish a target of net-zero municipal operations by the year 2030, as this includes decarbonizing our corporate fleet. For the scope of this Strategy, Dunsky Consulting looked at electrifying municipal light duty fleet vehicles. As of 2020, the corporate light duty fleet consisted of 541 vehicles, which include cars, pick-up trucks, vans and sport utility vehicles. An analysis of daily usage determined that while the pick-up truck segment has the highest maximum daily kilometres, all existing Canadian-sold EV options have enough battery capacity to cover the maximum required daily driving distance with a single charge.

To ensure all operational needs are met, Dunsky used their Fleet Electrification Optimization model to determine the most cost effective, and least disruptive Optimal electrification Plan (OEP) to achieve a full electric light duty fleet by 2030. The model considered the following:

Total Cost of Ownership: This includes upfront cost, maintenance cost, fuel and electricity costs, carbon tax rates.

EV Availability Timeline: This includes a list of announced and anticipated vehicles for both BEVs and PHEVs.

EV Price Forecast: This includes the cost of vehicle replacements for ICE, BEV and PHEV from 2020 to 2030 for all vehicle segments.

Fleet Optimization Algorithm: This determines the optimal year for vehicle replacement to achieve the EV fleet composition set target (i.e. 100% by 2030 for HRM)

On average, an electric vehicle purchased today will come at a cost premium of about 30% (about \$14,000) when compared to a standard gas vehicle. This cost premium will reduce year over year as EVs move towards cost parity, expected in the late 2020s. Although the initial capital costs will be higher to complete this transition, the accumulated annual operating savings associated with lower fuel costs and less maintenance result in lower total cost of ownership when compared to a business as usual scenario as shown in figures 4 and 5.

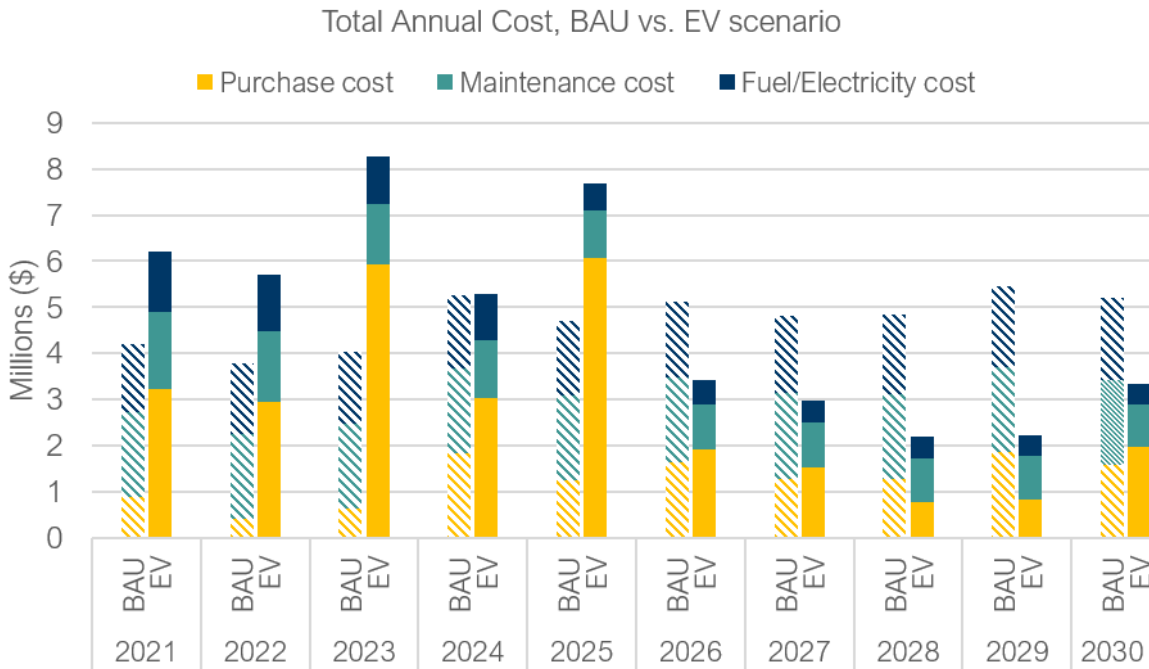


Figure 4: Annual cost of business as usual and 100% EV fleet scenarios

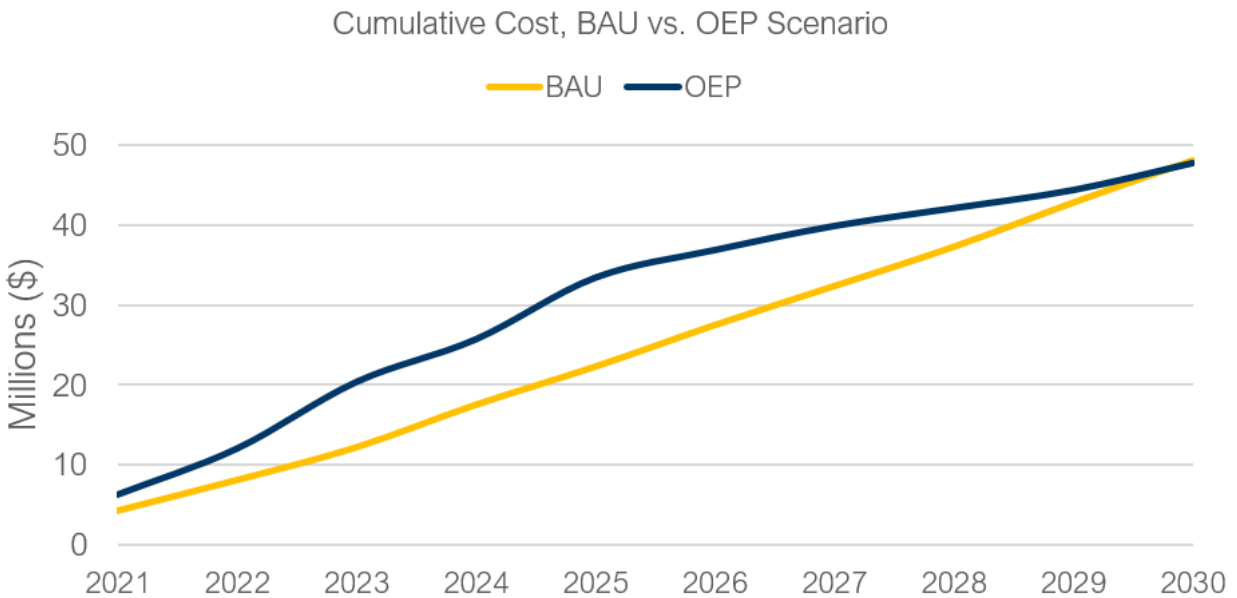


Figure 5: Cumulative cost of business as usual and 100% EV scenarios

Not included in the capital cost analysis is the available provincial and federal incentives or the benefits of bulk purchasing. In both the federal and provincial EV incentive programs, municipal fleets are eligible for 10 rebates annually, resulting in a potential total per vehicle rebate of \$8,000. This would reduce the first year's premium to less than 15%. To reduce this capital further, the Municipality should use its buying power to reduce unit costs through bulk purchasing. In recent years, Corporate Fleet has actively been looking to procure EV and hybrid vehicles, but there is a lack of vehicle options and availability in this area. While the recommended provincial ZEV mandate would alleviate this lack of availability in the long term, discussions

with Original Equipment Manufacturers has suggested that vehicle stock would be guaranteed if clear intent to purchase at bulk was shown. To obtain the most competitive pricing and ensure availability, staff plan to issue a multi-year tender to ensure dedicated stock at competitive pricing is in place. Once issued and closed, staff will report back to Council for budget considerations. With the available incentives and volume purchasing pricing, the premium for procuring electric vehicles should be closer to that of their internal combustion counterparts, reducing the net additional cost. Note that a portion of these costs may be covered by the Corporate Fleet annual budget for vehicle purchases.

Table 3: Estimated annual capital required for fleet transition

Municipal Fleet Electrification	2022/23	2023/24	2024/25	2025/26	2026/31	Total
Net Capital (after est. rebate)	\$3,100,000	\$2,900,000	\$5,900,000	\$3,400,000	\$12,500,000	\$27,800,000

To ensure the EVs purchased will have dedicated charging ports, design work has begun to outfit our fleet depots. The new fire headquarters at 10 Symonds Road in Bedford has been designed for 40 L2 charging sites. These sites will support the light duty fire fleet transition. The Mackintosh Depot replacement will also include some charging for its fleet vehicles. The other depots will be included for consideration in NRCan’s latest ZEVIP stream which prioritizes commercial and public fleet charging. To minimize capital costs, the depots will be designed for active load management. As most fleet vehicles are at home base by 5 PM, active load management can provide several vehicles a full overnight charge via a single circuit. Estimated annual capital for fleet charging infrastructure is outlined in table 4. These figures do not include cost sharing through ZEVIP (potentially 50%) or any other funding streams as these funds have yet to be secured. Tooling, safety equipment and staff training will be determined by the new Sustainable Green Fleet Analyst.

Table 4: Estimated annual capital required for fleet charging.

Municipal Fleet Electrification	2022/23	2023/24	2024/25	2025/26	Total
Capital	\$400,000	\$400,000	\$400,000	\$1,000,000	\$2,200,000

Figure 6 compares the annual emissions associated with a business as usual scenario and full fleet electrification, based on a 2020 grid emission forecast. This annual emission reduction may be greater by 2030 as the current Provincial government recently announced a target of 80% renewable electricity by 2030.

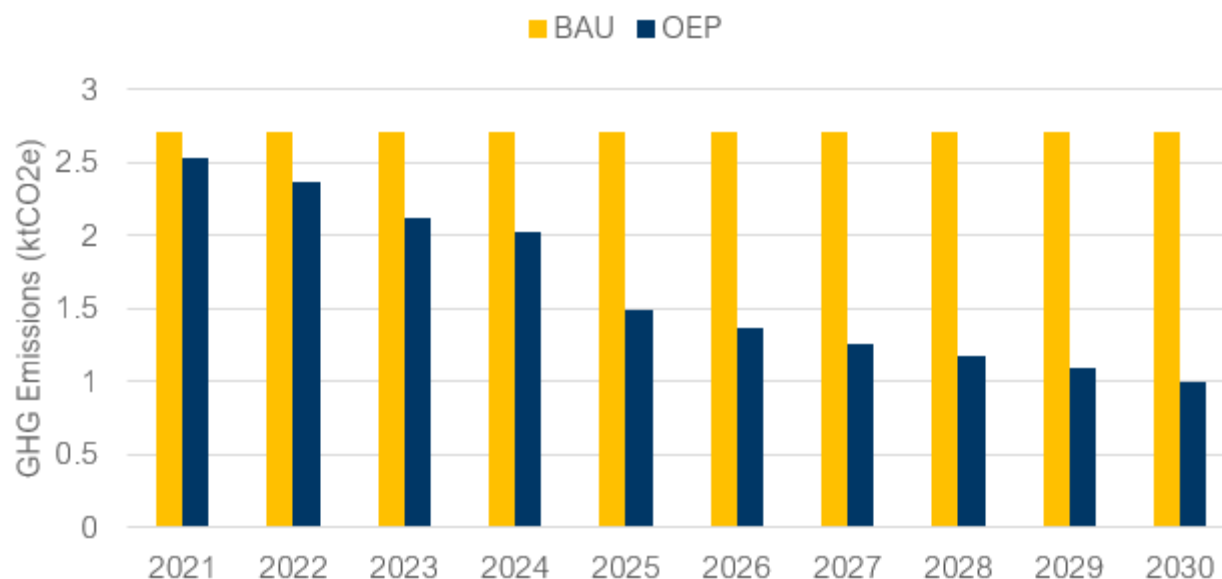


Figure 6: Annual emissions for business as usual and 100% EV scenarios, based on 2020 grid forecast

Summary

The Halifax Regional Municipality Electric Vehicle Strategy is the pathway to becoming an EV ready city. Approving the recommendations within this report will advance the targets of HalifACT, signal to the consumer that investments are being made to support the transition, address common barriers and misconceptions, and show municipal leadership. A full summary of recommendations and further supporting detail can be found in the Strategy in Attachment 1. Throughout implementation, partnerships and funding opportunities will be actively sought to ensure socially responsible investment.

FINANCIAL IMPLICATIONS

Capital

The capital cost estimate of the municipal contribution to the region wide public charger deployment plan and the full light duty fleet electrification was presented to Regional Council via the Strategic Initiatives Funding Plan⁸ report on January 20, 2021. The capital funding required for the fleet transition has been updated based on the final Strategy, and the revised funding need is outlined below in table 5. Sustained funding is required to successfully implement the major components of the Electric Vehicle Strategy.

Table 5: Strategic project funding requirements

Summary of Capital Costs	2022/23	2023/24	2024/25	2025/26	2026/31	Total
Public Charging	\$1,050,000	\$950,000	\$850,000	\$850,000	-	\$3,700,000
Fleet Vehicles	\$3,100,000	\$2,900,000	\$5,900,000	\$3,400,000	\$12,500,000	\$27,800,000
Fleet Charging	\$400,000	\$400,000	\$400,000	\$1,000,000	-	\$2,200,000
Capital	\$4,550,000	\$4,250,000	\$7,150,000	\$5,250,000	\$12,500,000	\$33,700,000

⁸ Strategic Initiatives Funding Plan – Jan 20.21 Budget Committee. <https://www.halifax.ca/sites/default/files/documents/city-hall/regional-council/210120bc5.pdf>

This summary of capital costs does not include future funding opportunities or rebates, aside from the existing federal and provincial vehicle rebate. These capital costs will be refined as funding opportunities are secured. To ensure responsible investments, an application has been submitted to the ZEVIP for 50% cost sharing for 115 public charging ports. This fund will be applied to future public and fleet charging needs.

There currently is enough budget in Capital account CB200012 – HalifACT 2050 – Climate Action Plan to initiate the public charging stations portion of the EV Strategy. The planned budget for the next three years in this account is in table 6 below. There are insufficient funds in this account to execute the entire Strategy as this account also funds other Climate Change action items such as deep energy retrofits, solar installations, green infrastructure projects and risk and vulnerability assessments of critical infrastructure. During the 2022/23 capital budget process, additional funds will be requested to support executing the action items in the HalifACT 2050 – Climate Action Plan.

Table 6: Current proposed Capital budget for HalifACT 2050 – Climate Action Plan

Budget	2022/23	2023/24	2024/25	Total
CB200012 – HalifACT 2050 – Climate Action Plan	\$2,000,000	\$3,000,000	\$4,000,000	\$9,000,000

The total capital for the fleet transition is estimated at \$27,800,000, which includes current vehicle rebates totalling \$80,000 annually. This capital cost will be fully offset by substantial lifecycle savings realized by reduced maintenance and fuel costs.

The EV Strategy as part of the Strategic Initiatives Capital Funding will be debt financed. Capital budgets for electric vehicles will be presented to Regional Council for approval based on detailed project plans, project readiness and capacity to deliver.

Operating

While the fee structure for public charging is still being developed, with estimated fees and usage rates, it is anticipated that the revenues from user fees will offset the cost of electricity and licensing fees.

The operating costs for the fleet vehicles and fleet charging stations should be significantly lower than with combustion vehicles in the business as usual scenario. Exact cost savings would depend on the fleet replacement schedule, vehicles usage and rates of both fuel and electricity. As an example, at current prices, the cost to drive an electric vehicle is approximately ¼ the cost to drive a comparable combustion engine the same distance. There is sufficient existing operating budget to cover the cost to operate and maintain vehicles and there will be operating cost savings as the fleet converts to electric vehicles.

RISK CONSIDERATION

A key risk is lack of capital and personnel resources to successfully implement at the rate required to achieve the goals of HalifACT. Implementing the municipal portion of the Public Deployment Plan and the full fleet transition will require the capital outlined in table 5 above. Although the initial capital costs will be higher to complete the fleet transition, the accumulated annual operating savings result in lower total cost of ownership when compared to a business as usual scenario. Public and fleet charging will require project management and coordination with the utility, property owners (as some fleet depots are leased) and charger manufacturers throughout operation. The fleet transition will require a modification in fleet logistics to ensure all vehicles are fully charged and operational needs can be met.

Currently, there is a lack of availability of EVs in the region. This scarcity, if not improved through a ZEV mandate or the multi-year tender recommended above, will pose a significant risk to completing the fleet transition by 2030. Staff will continue to explore options and report back to Regional Council if additional direction is required.

Overall, the risks associated with climate change are complex and multifaceted. Regional Council has declared a climate emergency and by not reacting promptly and effectively, Halifax could be faced with a reputational risk with its citizens, stakeholders, and other cities and governments. Climate change poses an immediate and long-term risk to human health, the built environment, and the natural environment.

If climate change is not considered in financial decision-making, there is the risk of investing poorly and maladapting, resulting in long-term costs that are exponentially higher. By not investing in and preparing for climate change, resiliency becomes more difficult, and the physical and economic impacts of climate change will have the greatest effect on the most vulnerable sectors of society.

COMMUNITY ENGAGEMENT

As outlined in the Strategy, engagement was conducted with leaders in the sector within the community. One of these stakeholders was the Electric Vehicle Association of Atlantic Canada, which represents both owners and those interested in EVs within the community. Additionally, significant community engagement relating to the items discussed above was completed during the development of HalifACT.

ENVIRONMENTAL IMPLICATIONS

There is significant environmental benefit to the recommendation as outlined in the report.

ALTERNATIVES

The Environment and Sustainability Standing Committee may choose to refuse or modify some or all of the recommendations outlined in this report.

ATTACHMENTS

Attachment 1: Halifax Regional Municipality Electric Vehicle Strategy

A copy of this report can be obtained online at halifax.ca or by contacting the Office of the Municipal Clerk at 902.490.4210.

Report Prepared by: Kevin Boutilier, Clean Energy Specialist, Environment & Climate Change, 902.719.8567



ELECTRIC VEHICLE STRATEGY

Supporting the municipality in achieving its electric mobility goals.

HALIFAX

Submitted to:

Prepared by:

Halifax Regional Municipality
PO Box 1749
Halifax NS B3J 3A5
Halifax.ca | boutilke@halifax.ca
902-719-8567

Dunsky Energy Consulting
50 Ste-Catherine St. West, suite 420
Montreal, QC, H2X 3V4
www.dunsky.com | info@dunsky.com
+ 1 514 504 9030



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Executive Summary

HalifACT, the municipality's long-term climate action plan to reduce emissions and help communities adapt to a changing climate, identified critical actions needed to decrease emissions from the transportation sector. Halifax Regional Municipality is looking to build on its climate leadership by planning for a city with decarbonized transportation.

The Halifax region has seen little electric vehicle (EV) adoption to date. Many barriers remain for residents who are looking to purchase an EV, including access to charging infrastructure, high capital costs, and limited availability of EVs.

The *Halifax Regional Municipality Electric Vehicle Strategy* provides ambitious yet achievable actions that will help catalyze EV adoption in a significant way over the next ten years by addressing the barriers to adoption specific to the Halifax region. The Strategy was developed through stakeholder engagement, a review of leading practices, as well as modeling and analysis.

To help reach HRM's ambitious EV targets, the following actions are recommended:

- **Deploy charging infrastructure** to alleviate the barrier associated with access to charging and enable residents to charge at work, in urban/suburban areas, and on highways.



- **Electrify the municipal light duty fleet by** following the optimal municipal fleet electrification plan which enables 100% transition to electric vehicles by 2030.
- **Enable greater access to home and workplace charging** by implementing policies requiring 100% EV ready parking in new residential construction and 10-20% EV ready parking in non-residential buildings.
- Advocate for sustained funding for both **provincial and federal purchase incentives** and a provincial **ZEV mandate**.
- **Support existing public education initiatives** through funding existing campaigns, sharing EV information on HRM's platforms, and training dedicated staff to support ongoing activities.

HRM's EV Strategy puts the Region on a pathway to deliver on its HalifACT climate action goals and enable greater adoption of electric mobility for all residents.

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Glossary of Terms and Acronyms

BEV	Battery electric vehicle
DCFC	Direct current fast charging
EV	Electric vehicle
EV energy management system (EVEMS)	A means used to control EVSE loads through the process of connecting, disconnecting, increasing, or reducing electric power to the loads and consisting of any of the following: a monitor(s), communications equipment, a controller(s), a timer(s), and other applicable device(s). By controlling EVSE loads, EVEMSs can ensure that the electrical capacity of a circuit is not exceeded. EVEMSs can thereby reduce the electrical capacity and associated infrastructure costs necessary to provide EV charging in a building. EVEMSs are sometimes referred to as “load sharing,” “power sharing” or “smart charging”.
EV Ready	Energized electrical outlet capable of providing “Level 2” charging
EV supply equipment (EVSE)	A complete assembly consisting of conductors, connectors, devices, apparatus, and fittings installed specifically for the purpose of power transfer and information exchange between a branch electric circuit and an electric vehicle. Also referred to as a “charging station”
EVA	Dunsky’s electric vehicle adoption model
HalifACT	HRM’s long-term climate action plan
Halifax Region	Refers to the community
Halifax Regional Municipality (HRM)	Refers to the municipal government
ICEV	Internal combustion engine vehicle
L2	Level 2 charging
MURB	Multi-unit residential building
NSPI	Nova Scotia Power Inc.
PHEV	Plug-in hybrid electric vehicle
TCO	Total cost of ownership
Zero emission vehicle (ZEV)	Vehicle which produces no emissions from the on-board source of power (e.g. electric vehicle, hydrogen fuel cell vehicle)

1. Introduction

1.1 – Context

In June 2020, Halifax Regional Council unanimously approved HalifACT¹, the municipality’s long-term climate action plan to reduce emissions and help communities adapt to a changing climate. HalifACT is seen as one of the most ambitious climate action plans in Canada, targeting steep and rapid reduction in emissions with a target of 75% reduction over 2016 levels by 2030 and net-zero by 2050. The pathway to net-zero was developed by assessing the opportunities within multiple sectors including buildings, energy supply, transportation, water, wastewater, and solid waste.

The transportation sector is the second highest energy consumer in the Halifax region, accounting for 30% of energy use and 20% of emissions². Particularly, light duty cars and trucks make up around 90%² of the overall emissions in this sector (Figure 1). To achieve the required emission reductions in this sector, HalifACT provides specific recommendations for increasing transit, active transportation, and electric mobility. Specifically, HalifACT recommends that HRM (the municipal government) takes significant actions to substantially increase the uptake of personal and commercial light duty electric vehicles (EVs). In addition, HalifACT recommends that HRM adopts a commitment to achieve net-zero municipal operations by 2030, which includes electrifying all municipal fleet vehicles.

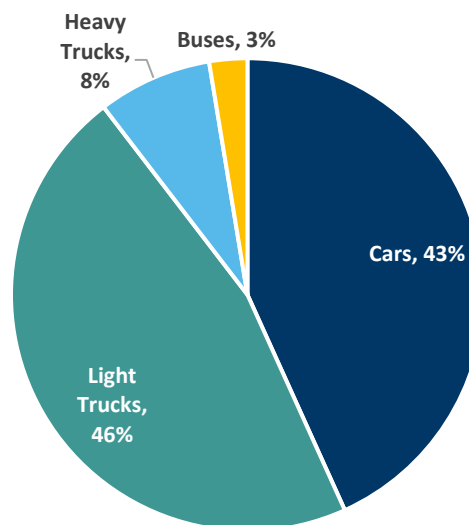


Figure 1 — Breakdown of the Halifax region’s 2016 transportation sector emissions by vehicle segment

This report lays out the *Halifax Regional Municipality Electric Vehicle Strategy*, which consists of a list of direct and indirect strategic actions that will put the Halifax region on the path to accomplish its ambitious electric mobility objectives.

1.2 – Barriers to Electric Vehicle Adoption

Despite growing sales globally and across Canada, EVs still face several barriers that impede their widespread adoption; most notably:

¹ [HalifACT: Acting on Climate Together](#)

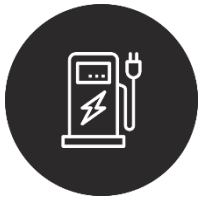
² [Halifax Regional Municipality: Energy use and Greenhouse Gas Emissions Baseline Inventory, 2016 & Business-As usual Scenario to 2050](#)



Incremental Purchase Cost: The higher upfront cost of EVs relative to their Internal Combustion Engine Vehicle (ICEV) equivalent is a barrier to EV adoption. Although lifetime cost savings from avoided gasoline or diesel fuel costs, combined with reduced maintenance costs, can result in a lower total cost of ownership (TCO) for EVs, many consumers do not use a TCO approach when making decisions about major purchases.



Home Charging Access: With 80-90% of EV charging expected to take place at home, lack of access to home charging for some segments of the population will limit their ability to adopt Battery Electric Vehicles (BEVs) – as opposed to Plug-In Hybrid Electric Vehicles (PHEVs). Specifically, in large urban centers, households that live in multi-unit residential buildings often face additional technical and non-technical barriers that make it challenging to install charging equipment that they can access from their usual parking location. Additionally, some households do not have access to dedicated garages or driveways.



Range anxiety and public charging access. While most EV users will charge their vehicles at home, deployment of public charging infrastructure is critical for alleviating “range anxiety” which is the fear of running out of charge away from home. Gaps in geographic coverage of public infrastructure can limit the ability to undertake long-distance travel. In contrast, insufficient capacity of charging infrastructure can lead to concerns about the availability of the infrastructure and potential lineups. Both real and perceived lack of public charging result in barriers to EV adoption. While access to public charging can enable PHEV users to cover greater distances without switching to gas power, range anxiety is only really a concern for BEV users.



Vehicle Availability: The limited availability of existing EV models at local dealerships, as well as the lack of variety in available EV models, is a significant barrier to EV adoption. This is predominantly the case for larger vehicle segments (e.g. SUVs, pick-up trucks, minivans), for which EV models are currently limited or unavailable.



Lack of Awareness: Limited information - or misinformation - about EVs, their availability, charging options, and TCO can lead consumers to focus more on the initial cost of EVs and ignore the long-term benefits

1.3 – The Halifax Region EV Landscape

1.3.1 – EV adoption

In Nova Scotia, EV adoption is lagging behind other jurisdictions across North America, with EVs representing less than 1% of new vehicle sales. In the province, there are roughly half a million light-duty vehicles currently registered and about 50,000 sold annually. By the end of 2019, EVs only represented

0.3% of annual vehicle sales, with approximately 400 EVs on the roads (≈ 250 EVs registered in HRM³). Compared to other parts of Canada, the Halifax region has had a relatively limited EV market, falling significantly behind other leading markets. Specifically, EV adoption in Canada today is centered in the three provinces that have provided, or currently provide, purchase incentives, among other supporting policies and investments; Quebec, Ontario, and British Columbia. Figure 2 outlines the number of EV sales per province which has Nova Scotia ranking 6th in the country.

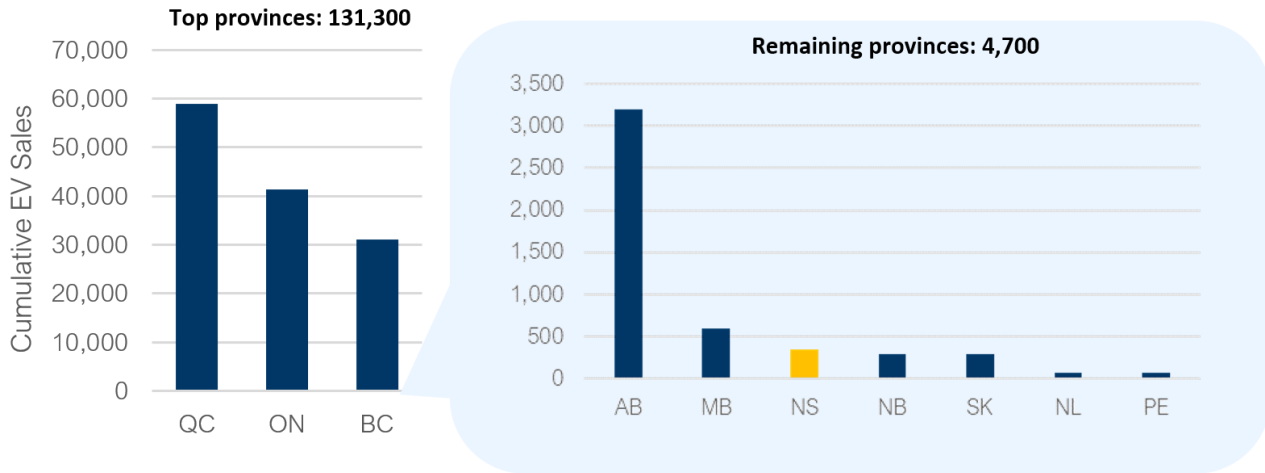


Figure 2 — Cumulative EV sales by province as of Q3 2019⁴

1.3.2 – Public Charging Infrastructure

There has been some progress made to date in Nova Scotia in terms of the deployment of DCFC infrastructure, but substantially more investment is required. While most of this has been led by Nova Scotia Power Inc. (NSPI), there is uncertainty around future investments given that the Nova Scotia Utility and Review Board rejected NSPI's latest request to make rate-based investments in charging infrastructure. **Currently, it is not clear who will be involved in public infrastructure deployment within the Halifax region.**

³ Data retrieved from the Nova Scotia Department of Energy and Mines

⁴ [Electric Mobility Canada \(2019\), "Electric Vehicle Sales in Canada – Q3 2019"](#)

1.3.3 – EV Policies

In the Canadian context, provincial incentives have proven to have a clear impact on adoption, as demonstrated in Quebec, British Columbia, and Ontario. There is also evidence of the long-term impact of incentives, with Ontario’s EV market share of new vehicle sales remaining well ahead of other provinces despite their rebates ending in 2018. While the lack of provincial incentives in recent years has put Nova Scotia behind the leading jurisdictions in Canada, **newly implemented provincial incentives will help alleviate financial barriers and encourage further adoption.**

One of the key barriers to adoption in Nova Scotia is the limited availability of EV models in dealerships. Dunsky’s analysis showed that only 1 in 10 dealerships in Nova Scotia have at least one EV available for purchase. This has been further echoed by local stakeholders who acknowledged long wait times and a complete lack of availability of certain models. **Currently, Nova Scotia does not have a ZEV mandate which is the most effective** tool available to deal with the supply constraint on EVs.

While the percentage of residents living in multi-unit residential buildings (MURBs) is lower in the Halifax region than in some other major cities, access to charging in MURBs is still an important barrier to adoption. **The Halifax region does not currently have any building requirements for EV charging in private parking spots.**



A provincial ZEV mandate combined with provincial incentives can significantly increase EV uptake in Nova Scotia – exceeding the Federal target of 30% new vehicle sales.



Electric Vehicle Adoption in Nova Scotia: 2020 – 2030

*Prepared by Dunsky Energy Consulting
For Ecology Action Centre*

1.4 – Developing the Strategy

1.4.1 – Objective

To realize the emission reductions required from the transportation sector, HalifACT provided HRM with a clear direction to take serious actions to accelerate the transition to EVs. The Halifax region is currently facing specific barriers to EV adoption that require a tailored approach and strategic actions. We developed this made-for-Halifax strategy to **provide ambitious yet achievable actions that will help catalyze EV adoption in a significant way over the next ten years** by addressing the barriers to adoption specific to the Halifax region.

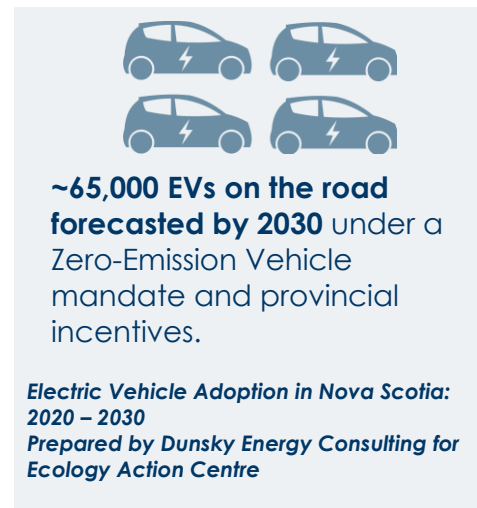
1.4.2 – Methodology

As part of the procurement process, HRM had identified the need to develop detailed plans for both municipal fleet electrification and public charging infrastructure. For that reason, the strategy focuses on providing HRM with a clear path forward on those fronts. In addition, we identified and recommended additional actions that can be implemented or supported by HRM which will be critical in developing a

thriving EV ecosystem and move the Halifax region towards its mobility goals. As part of the process, we leveraged our deep expertise and experience in clean mobility and EV policies and our proprietary models and tools, reviewed EV strategies in other jurisdictions, and conducted stakeholder engagement with HRM staff and leaders in the sector within the community.

Modeling and Analysis

The Strategy leveraged results from a recently published report by the Ecology Action Centre, *Electric Vehicle Adoption in Nova Scotia 2020-2030⁵*, which evaluated the potential for EV adoption in the province under various policy scenarios. The study was conducted by Dunsky and leverages the use of our Electric Vehicle Adoption (EVA) model. We used the results under the most ambitious adoption scenario from the adoption model to determine the appropriate level of charging infrastructure necessary and to develop a suitable public charging infrastructure plan. Additional modelling was conducted to develop the municipal fleet electrification plan using Dunsky's Fleet Electrification Optimization model. The model was used to determine the optimal path for electrification while reducing costs and maximizing benefits.



Stakeholder Engagement

In order to capture a broad spectrum of perspectives, a variety of stakeholders were engaged to inform the development of the strategy including HRM staff and external key stakeholders from the community (Appendix A). Interviews were conducted to help shape the Strategy and build support throughout the process. Following the development of the draft Strategy, a workshop was held to solicit input on next steps, obtain support for implementation of the strategy, and ensure no major gaps exist.

Overall, there was broad support for the strategy from all stakeholders consulted. Key insights include:

- Stakeholders believed that the strategy's public charging infrastructure plan provided fulsome geographic coverage that is aligned with the ambition of the HalifACT plan.
- HRM should engage with NSPI and leverage their experience in charging infrastructure deployment.
- Stakeholders indicated the importance of equity considerations in the geographic distribution of infrastructure.
- HRM should prepare an information package to engage with the private sector for partnerships for charging infrastructure deployment.

⁵ <https://ecologyaction.ca/press-release/fuelling-change-electric-vehicles-ecology-action-centre-calls-provincial-action>

- HRM should engage with real-estate developers as part of its process of implementing EV policies in new construction.
- A suggestion was proposed to create an on-going working group for electric mobility that brings together key stakeholders and ensures coordination.

1.5 – Report Purpose and Structure

This report provides the technical details and context for the Strategy. It includes a list of direct and indirect strategic actions that will support the Halifax region's transition to decarbonize light duty transportation. Direct actions are those that can be implemented by HRM while indirect actions are those that HRM can help advocate for and/or support their implementation.

The strategy includes four key areas of focus:

1. **Public Charging Infrastructure:** this section includes a detailed plan of the number of chargers needed within the Halifax region, specific recommendations on geographical locations, and overall cost estimates.
2. **Fleet Electrification:** this section provides HRM with a clear roadmap for electrifying its light duty fleet to achieve its 100% EV target in the most cost effective and the least disruptive way.
3. **Municipal EV Policies:** this section includes specific recommendations on municipal policies that can help increase access to home charging which will alleviate a significant barrier to EV adoption.
4. **Advocacy and Support:** this section covers critical actions that are outside of HRMs direct control but which they can advocate for.

Technical details of each area of focus are covered under dedicated sections in the report. This report will be accompanied by a public-facing document that will briefly and concisely summarize the key action areas laid out in this strategy.

2. Public Charging Infrastructure

2.1 – Public Infrastructure and EV Adoption

A key lever for enabling EV adoption is public charging infrastructure. While most charging is typically done at home overnight, public charging provides additional flexibility for EV drivers covering longer distances, easing range anxiety. Range anxiety is the concern that the car's battery will run out before finding a location to charge at. Along with easing range anxiety, public charging provides an alternative charging option for those without access to home charging. Visibility of public charging also signals to consumers that investments are being made for EV infrastructure and can improve adoption levels.

2.2 – Types of Charging Infrastructure

2.2.1 – Direct Current Fast Charging

Direct Current Fast Charging (DCFC), often referred to as Level 3 charging, is the fastest way to charge an EV. They provide a charging power of 25 kW – 350 kW, with 50 kW chargers being the most common today. DCFC's offer a 20 – 60 minute charge for 80% of battery capacity depending on the vehicle and charge rate. A 50 kW DCFC can replenish 300 km of range per hour of charging, while newer equipment at 150 kW and above can accomplish the same in 30 minutes or less. The speed of DCFC allows for quick and convenient charging for EV owners without access to home charging and eases range anxiety, enabling longer trips.

Table 1— Charging time needed to add 300 km for DCFC

Time needed to add 300 km			
	Charging Power	Typical passenger car (20 kWh/100 km)	Typical light-duty truck (30 kWh/100 km)
DCFC	50 kW	1 hour and 12 minutes	1 hour and 48 minutes
	100 kW	36 minutes	54 minutes
	150 kW	24 minutes	36 minutes
	350 kW	10 minutes	15 minutes

Currently the Halifax region has three DCFC stations. High costs and low revenue opportunities mean there is a lack of investment in this space. An illustrative example of the business case based on a 10% utilization rate (maturing market) is presented in Table 2. Early deployments have been led by NSPI, but there will be a need for ongoing expansion in the future to fill the gaps by densifying charging in urban/suburban areas and adding sites on highway corridors. Overall, HRM will need to initially step in to fill the market gap as well as advocate for NSPI to deploy fast chargers themselves or provide a demand charges rate structure that helps with improving the business case.

Even with a higher usage fee than what is currently being used in Nova Scotia, revenue from a fast charger will barely cover operation costs with no prospects of a return on capital costs.



Table 2 — Business case assessment of a DC Fast Charger in the Halifax Region

Expenses		Assumptions
Capital Cost	\$150,000	150 kW DCFC charger including equipment and installation costs
Demand Charges/year	\$18,000	\$10 per kW demand charge
Energy Charges/year	\$6,570	10% utilization rate, 75 kW average charging power, and \$0.10/kWh electricity rate
Annual Operation & Maintenance	\$1,500	Expected DCFC annual O&M costs including planned and unplanned repairs as well as site maintenance ⁶
Annual Costs	\$26,070	
Revenue		Assumptions
Scenario 1	\$13,140	Current usage fee (\$0.25/min or \$15/hour)
Scenario 2	\$26,280	Hypothetical usage fee (\$0.50/min or \$30/hour)

⁶ [EVSE Pilot – Costs and Reliability - AVISTA](#)

Urban/Suburban fast charging hubs:

To reduce barriers experienced by those without access to home charging, DCFC works best at convenient locations that people are already visiting regularly, like grocery stores or malls. Making charging accessible in a location where drivers can charge while doing short tasks, such as eating or shopping, is a convenient way for people to charge their vehicle. The ideal geographic distance should allow for everyone to reach a DCFC charger within a 5-minute drive in populous urban/suburban areas.



Figure 3 — Petro-Can Direct Current Fast Charging stations

Highway fast charging: DCFC should be deployed along highway corridors so drivers can quickly charge up on longer trips. Having frequent stations (within 60 km of each other) eases range anxiety and placing stations by amenities like restaurants or stores adds convenience for drivers.

Table 3 — Examples of DCFC site locations

Urban/Suburban Fast Charging Hubs	Highway Fast Charging
<ul style="list-style-type: none">• Grocery stores• Shopping centers• Central restaurants	<ul style="list-style-type: none">• Rest stops• Fast food restaurants• Coffee shops• Visitor centers• Gas stations

In the short-term, urban/suburban DCFC hubs should be deployed in convenient locations beside amenities in MURB dense areas and along highway corridors to ensure stations are within 60 km of each other. In the medium to long term, additional ports should be added to the most heavily utilized stations to avoid congestion and additional stations should be added to fill any charging gaps found.

2.2.2 – Level 2 Charging

A typical Level 2 (L2) charger (7.2 kW is most common today) can charge an EV at a rate of approximately 40 km of range per hour. L2 chargers are most commonly used at homes, workplaces and public charging locations. While less impactful than DCFC due to their slower charge times, the lower cost of L2 charging makes it easier to deploy and can be leveraged where longer charge times are not a hinderance to drivers. Currently, the Halifax region has approximately 40 L2 chargers that are primarily located in the downtown core.

Table 4 — Charging time needed to add 300 km using L2 chargers

Time needed to add 300 km			
	Charging Power	Typical passenger car (20 kWh/100 km)	Typical light-duty truck (30 kWh/100 km)
Level 2	7.2 kW	8.3 hours	12.5 hours
	20 kW	3 hours	4.5 hours

On-street charging: Deploying on-street, curbside charging in MURB dense areas can potentially alleviate charging barriers for those that do not have access to home charging, provided they are conveniently located. Dedicated on-street parking spots for EV charging can provide a substitute for home charging, particularly for those who do not have access to off-street parking, enabling the convenience of overnight charging close to home. Additionally, on-street charging can be deployed in urban commercial areas (e.g. downtown core). The complexity of installing charging in the curbside environment, typically requiring underground wiring, dedicated mounting pedestals and cable management, leads to higher overall costs than installations in off-street parking lots. On-street charging also requires supporting parking policy to established parking spaces that are reserved for EVs while charging.

Workplace Charging: L2 stations are ideal for workplace charging as drivers can plug in when they arrive and have a fully charged vehicle eight hours later when leaving work. Workplace charging sites can either be in a private parking lots or in public parking lots that are primarily used for workplace parking.

Public parking lots: A type of off-street charging that places charging sites at locations where people would leave their car parked for several hours. This includes parking lots at locations like parks, rec centers, retail outlets, or movie theatres. This segment also includes park and ride sites, where a driver



Figure 4 — On-street level 2 charging in Montreal, Quebec

could opt to park their car and continue their journey using another mode of transportation (i.e. public transit).

Table 5 — Examples of level 2 charging site locations

On-street charging	Workplace Charging	Public Parking Lots
<ul style="list-style-type: none"> • City streets that have high levels of on-street parking 	<ul style="list-style-type: none"> • Private workplace parking lots • Public parkades used for workplace parking 	<ul style="list-style-type: none"> • Public parks • Recreation centres • Movie theatres • Retail and grocery stores • Park and rides

In the short term L2 on-street charging should be deployed on residential streets in MURB dense areas, workplace parking lots and urban/suburban parking lots in populous areas. Park and ride locations can incorporate L2 stations depending on the typical usage of those lots and whether EV drivers are likely to benefit from charging there. The medium to long-term strategy will depend heavily on home charging access in MURBs. If charging access does not substantially improve in MURBs then additional curbside and workplace L2 charging will need to be added.

2.3 – Municipal Initiatives in Public Infrastructure

Municipal governments are playing a critical role in public infrastructure across Canada, with Toronto, Victoria, and Montreal leading the way.

2.3.1 – Toronto, Ontario

In 2020 the City of Toronto developed an Electric Vehicle Strategy⁷ that identifies a range of actions to help the City achieve its 2050 goal of having all transportation powered by zero carbon energy sources. The EV Strategy’s ultimate objective is having 100% of light-duty vehicles being zero emitting by 2050.

To meet these long-term goals, significant EV uptake is required in Toronto. Currently, approximately 0.6% of vehicles registered in the City are EVs. There are also currently very few public EV charging stations across the city: 131 L2 sites (602 ports) and 30 DCFC sites (102 ports). While there are approximately 20 City-owned EV charging stations in Toronto, 19 of which are L2 and 1 that is DCFC, these stations are only available to City vehicles. Public, city-owned charging infrastructure pilots are currently underway. Toronto’s 2020 EV Strategy identifies an overall need for 650 DCFC ports and 10,000 L2 ports in public locations by 2030.

Toronto currently has the following programs and strategies to address charging infrastructure needs in the City:

⁷ <https://www.toronto.ca/wp-content/uploads/2020/02/8c46-City-of-Toronto-Electric-Vehicle-Strategy.pdf>

- **Residential On-street EV Charging Station Pilot:** A pilot project is underway that will install on-street public charging infrastructure in residential permit parking areas. Plans call for 13 stations at 7 locations that may include electrical and streetlight poles. The charging station parking spots are open to all electric vehicle owners with a “Level 2” connection on their vehicle. To use the stations, EV drivers can register for an account online with FLO, Canada’s Largest EV charging network. Once signed up, users can download the app and order a FLO card that they will use to activate the station and charge their vehicle. Toronto Hydro, in agreement with the City of Toronto, established the EV charging rates that apply to the chargers, which are competitive with the cost of other public charging stations in Toronto. Rates during the day are \$2 per hour, while overnight will be a flat \$3 fee. A higher day rate encourages users to free up the station for daytime drivers but the lower flat fee at night means residents can leave their car overnight and drive off in the morning fully charged.⁸ Led by Toronto Hydro and Transportation Services.
- **Downtown On-street EV Charging Station Pilot:** A pilot project that will install on-street public charging infrastructure in Toronto’s downtown core. Current plans call for 3 stations at 2 locations. Led by Toronto Hydro and Transportation Services.
- **Parking Garage Charge Station Pilot Project:** A pilot project that will install charging infrastructure in Toronto Parking Authority (TPA) operated parking facilities. Led by Toronto Hydro and TPA.
- **Toronto Green Standard:** The Toronto Green Standard (TGS) outlines sustainable design requirements for new private and city-owned developments. The TGS includes mandatory (Tier 1) and voluntary (Tiers 2 – 4) guidelines. They include standards for charging infrastructure including mandatory requirements for the installation of charging infrastructure and EV-capable parking spots in new developments. Led by City Planning.
- **Toronto Hydro’s EV Charging Infrastructure Strategy:** Toronto Hydro is continually examining the impacts of EV charging on the grid and accommodating within its infrastructure planning activities.
- **Waterfront Toronto:** An initiative involving the federal, provincial and City governments to renew Toronto’s waterfront. The initiative requires all buildings governed by Toronto Waterfront to meet minimum green building requirements, which include minimum requirements for charging infrastructure (i.e. 2% of parking spaces require L2 charging infrastructure, with the remaining spaces being EV-ready).

2.3.2 – Victoria, British Columbia

The City of Victoria has committed to expanding public EV charging options to help meet the climate change targets of an 80 per cent reduction in greenhouse gas emissions from 2007 levels and a switch to 100 per cent renewable energy by 2040 as outlined in the City’s Climate Leadership Plan.

The Victoria region has made remarkable progress on electric vehicle (EV) adoption to date, with the highest percentage of EV sales anywhere in Canada. Victoria’s Electric Vehicle Strategy identifies actions to help the City of Victoria meet its Climate Leadership Plan goal of renewable energy powering 30% of passenger vehicles registered in Victoria by 2030.

⁸ <https://electricautonomy.ca/2020/11/07/toronto-curb-side-ev-charging/>

Within the City of Victoria⁹, there were 825 EVs on the road in 2020, representing approximately 12% of new vehicle sales and nearly 2% of all vehicles registered in Victoria. The broader Capital Regional District had 5,698 EVs on the road in 2020.

The City of Victoria only has 74 Level 2 public charging ports, and no fast charging ports, while the broader Capital Regional District has 210 Level 2 ports and 29 DCFC ports. Since 2013, the City has been investing in EV charging infrastructure and now owns and operates 13 public Level 2 chargers located in five City-owned parkades as well as six recently installed curbside chargers on Broad Street.

Funding for the chargers and the installation has been provided in part by NRCAN's Zero Emission Vehicle Infrastructure Program and the CleanBC Go Electric Program in collaboration with BC Hydro. There is a fee for use of the chargers and users will be required to limit their stay to 40 minutes. Beginning on January 4, 2021, a \$1 per hour EV charging fee came into effect for all City-owned EV chargers, including those in parkades and along Broad Street. Parking and EV charging fees can be combined and paid for using the Flo App or using a preloaded Flo purchase card on Broad Street and in the Johnson Street parkade. Parking restrictions are in place to ensure that only EVs that are charging are parked in the EV parking stalls.

The City of Victoria has been working with BC Hydro to install the city's first DCFC station with two ports at the south end of Store Street. Construction is underway with the chargers expected to be ready for public use by April 2021.

Going forward, the City of Victoria is currently working with Dunsky Energy Consulting to identify needs for public Level 2 and DCFC charging ports required to achieve the City's target of zero-emission vehicles representing 30% of vehicles in circulation by 2030.

2.3.3 – Montreal, Québec

Quebec is a leading market for EV adoption in Canada thanks to a range of programs and policies, including financial incentives, a ZEV mandate that sets mandatory targets for EV sales for automakers, and a robust public charging ecosystem. Since its launch in 2012, Hydro Quebec's Electric Circuit public charging network has deployed over 3000 public charging ports, including 450 DCFC ports as of early 2021. In 2018, Hydro Quebec's regulator approved a plan to deploy 1600 DCFC ports over 10 years, on the basis that this deployment would support increased adoption of EVs and an overall increase in revenue. This revenue would come from electricity sales through residential charging that would offset the costs of DCFC deployment. This approval has led to an acceleration of Hydro Quebec's deployment of DCFCs across the province.

The City of Montreal has partnered with the Electric Circuit for deployments within the City, including both public Level 2 and DCFC ports. As of early 2021, there were over 1000 Level 2 ports and 17 DCFC ports on the Electric Circuit network within the City of Montreal. While Hydro Quebec covers the full cost of

⁹ The City of Victoria is a relatively small portion of greater Victoria, with a population of 85,792 out of a total 383,360 in the Capital Regional District.

installation and operation of DCFC ports within Montreal, Montreal assumes all costs for Level 2 ports. Over 500 of the City's Level 2 ports are installed in curbside locations, particularly in dense neighbourhoods with limited off-street parking. Montreal's 2020-2030 Climate Plan¹⁰ includes an action to grow this network further through ongoing collaboration with Hydro Quebec.

Usage fees for Electric Circuit charging stations in Montreal include either a \$2.50 per session flat fee or \$1 per hour for Level 2 chargers (including curbside chargers) and \$12 per hour for 50 kW fast chargers.

2.4 – Halifax Region Context

HalifACT, HRM's ambitious climate action plan, aims to shift the Halifax region to a low-carbon economy by 2050. HalifACT acknowledges that wide-spread adoption of EVs will require a significant amount of coordination with local partners and industry specialists to prepare for a shift from gasoline to electricity.¹¹ Significant deployment of public infrastructure is required to drive adoption levels and be ready for increased charging needs. These deployments will provide EV drivers with access to significantly more charging infrastructure and alleviate important barriers to adoption.

Nova Scotia has seen some investment in public charging infrastructure thanks to initiatives led by NSPI and some private organizations with the support of the federal government through Natural Resources Canada's Electric Vehicle and Alternative Fuel Infrastructure Deployment Initiative. At the end of 2019, 66 L2 stations and 17 DCFC stations were installed across the province. Unfortunately, there is uncertainty around future investments from the NSPI given that the Nova Scotia Utility and Review Board rejected NSPI's latest request to make rate-based investments in charging infrastructure. Specifically, there are currently 40 L2 stations and three DCFC stations¹² in the Halifax region as shown in Figure 5.

The first noticeable gap with current public infrastructure is the lack of fast charging. There are only three DCFC sites, one of which is solely for charging Tesla vehicles and is located outside of the urban core. With only one DCFC Tesla station along a highway corridor, charging sites along major highway routes will be needed to ease range anxiety and enable quick and convenient charging on longer trips. The other two DCFC sites are in Spryfield and the South end of the peninsula. This is not enough for the more populous neighbourhoods, especially on the peninsula. DCFC hubs will need to be added in densely populated urban and suburban neighbourhoods to provide charging for those without access to home charging.

¹⁰ <https://montreal.ca/en/articles/montreal-climate-plan-objective-carbon-neutral-2050-7613>

¹¹ https://www.halifax.ca/sites/default/files/documents/about-the-city/energy-environment/HRM_HaliFACT_vNew%20Logo_.pdf

¹² Vehicle dealerships fast charging sites have been excluded as they typically see minimal use

While there is decent geographic coverage of L2 off-street charging sites across the more densely populated urban and suburban neighbourhoods, most of the charging sites only have 1-2 ports. While geographical coverage is important, having charging hubs with multiple ports creates a more reliable system that will be more convenient for the end user. It is also important to note that the current L2 sites are primarily for off-street charging, located in parking lots of amenities such as shopping centers, grocery stores and public buildings. While off-street charging is convenient for many people, there is a lack of on-street charging in residential areas that can serve as a substitute for those without easy access to charging at home.

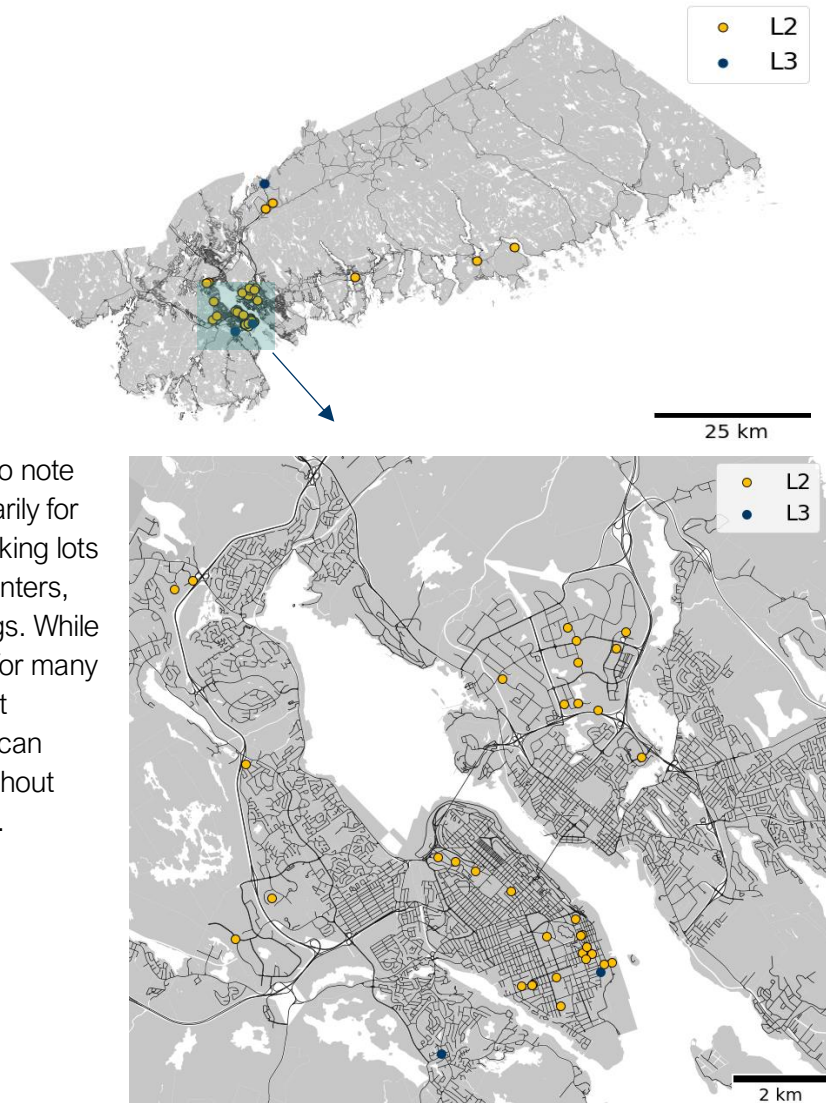


Figure 5 — Current public charging infrastructure in HRM

Table 6 — Location of current L2 charging sites

Site Name	Number of ports
Halifax Seaport Farmers Market	4
Dalhousie University - Ocean Science Building	1
Halifax Central Library	3
Nova Centre	2
Ikea Halifax	4
Scotia Square Parkade	2
The Deanery Project	1

In summary:

- Filling the public charging gaps is necessary to meet HRM's EV goals, but unfortunately the business case to deploy charging infrastructure is weak, especially for DCFC infrastructure which can be expensive to operate.
- Public infrastructure is needed to alleviate range anxiety and reassure potential EV buyers, but ultimately EV drivers do most of their charging at home, limiting the potential for revenue generation through usage fees.
- With lack of interest in private investment in charging infrastructure, and no clear mandate for NSPI to make these investments, there is a clear gap on who will be deploying charging infrastructure within the Halifax region in the near term.
- HRM can play a crucial role in addressing these market failures by filling gaps in the public charging infrastructure landscape in the region.

2.5 – Public Charging Infrastructure Plan

2.5.1 – Methodology

Dunsky's EV Adoption (EVA) Model was used to determine the necessary levels of public charging infrastructure needed to be deployed to support the EV population resulting from 30% EV market share (new sales) by 2030. Combined with a qualitative assessment of charging locations, we developed a detailed public infrastructure deployment plan that provides numbers of chargers needed, types of chargers, and geographical considerations.

The EVA Model incorporates learnings from leading jurisdictions regarding optimal levels of charging infrastructure deployment to support a growing EV population. See Appendix B for more details on the EVA modeling methodology. In 2020, Dunsky was retained to model province-wide adoption scenarios for Nova Scotia on behalf of the Ecology Action Centre¹³. Results from this analysis were leveraged to identify potential trajectories for EV adoption and required infrastructure deployment levels within the Halifax region.

To validate the current landscape in Nova Scotia in terms of the effect of policies and intervention on EV adoption, our team conducted consultations with key stakeholders in the Halifax region. Relevant market actors included local and provincial governments, utilities, industry associations, and automotive dealerships. Interviews focused on understanding the challenges and barriers specific to Nova Scotia.

Along with stakeholder consultation, the public infrastructure deployment plan was created by conducting a qualitative assessment of public infrastructure gaps. Gaps were identified by assessing the following:

- Baseline charging site locations¹⁴
- Driving distance¹⁵
- Multi-unit residential building dense areas¹⁵

Figure 6 shows the number of multi-unit residential buildings across the Halifax region. Through our assessment we concluded that MURBs of five stories or more are mostly centered in the downtown core and surrounding areas. This indicates that the focus needs to be on off-street and on-street charging hubs on the peninsula and the surrounding areas to accommodate those without home charging access.

Unlike larger cities like Toronto or Vancouver, most of the Halifax region's population does not live in MURBs as it consists of a mix of urban, suburban, and rural regions. Toronto has approximately 30% of their population living in buildings that are 5 storeys or more, while the Halifax region has 10%. That 10%

¹³ <https://ecologyaction.ca/press-release/fuelling-change-electric-vehicles-ecology-action-centre-calls-provincial-action>

¹⁴ Data for baseline charging site locations was retrieved from PlugShare's EV Charging Station Map and NRCan's Electric Charging and Alternative Fuelling Stations Locator tool

¹⁵ Data was retrieved from the Canadian Urban Sustainability Practitioners Energy Poverty and Equity Explorer Tool

of the population is concentrated on the peninsula, with certain neighbourhoods having up to 87% of households in buildings with 5 or more storeys.

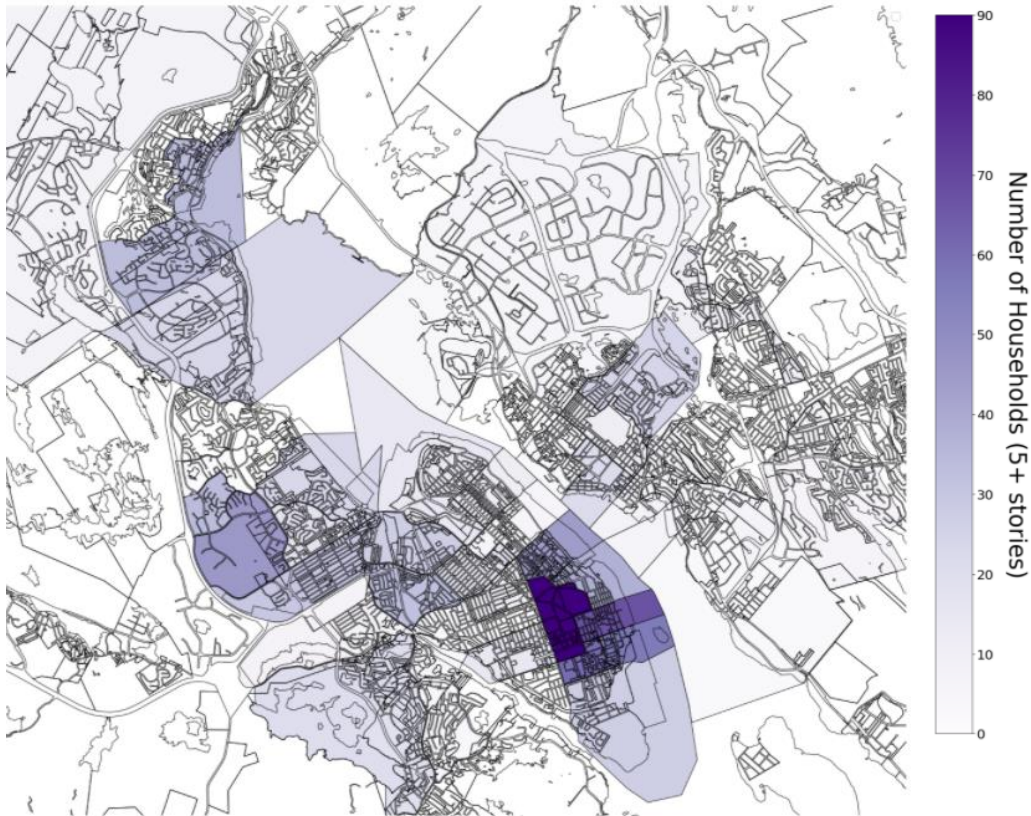


Figure 6 — Heat map of households in a building that has 5 or more storeys in the urban core of the Halifax region

Figure 7 shows the variability of the median cumulative driving distance (one-way) across the Halifax region. Through our analysis, we found that residents in central urban/suburban neighbourhoods surrounding the peninsula are not driving a significant distance in their commute (<10 km one-way). However, residents in the surrounding suburban/rural regions are driving longer distances as many are likely commuting into the urban core for work. Residents in the more rural, east end of the Halifax region tend to drive less as they are not likely commuting into the urban core. These insights indicate the need to improve charging access along commuting highways and improve workplace charging for those commuting into the peninsula.

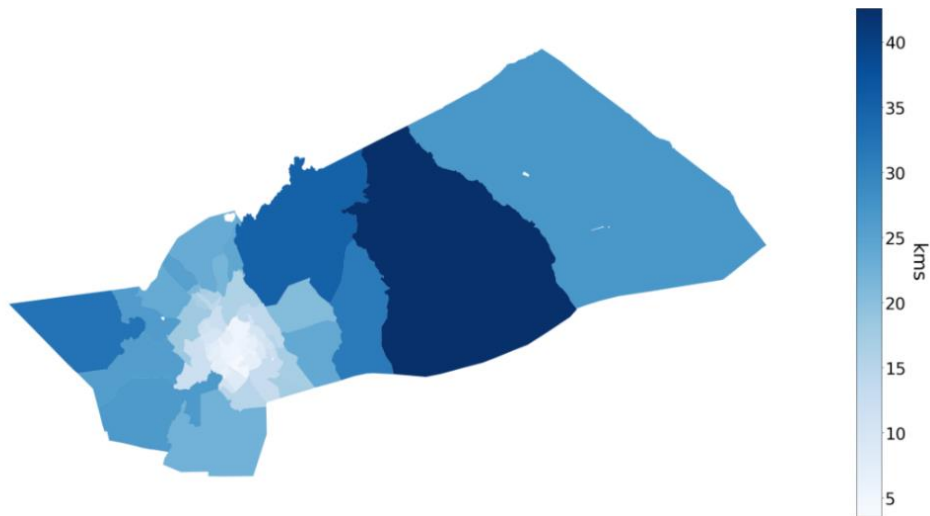

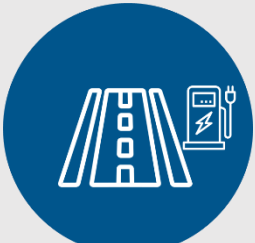




Figure 7— Heat map of median driving distance (km) one way in the Halifax region

2.5.2 – Recommended Charging Infrastructure

The following categories are necessary for implementing a successful public charging plan in the Halifax region:

 <p>Urban/Suburban DCFC hubs</p>	 <p>DCFC highway charging</p>
 <p>L2 on-street charging</p>	 <p>L2 off-street parking</p>

The charging categories highlighted above were selected to cover a range of use cases for EV charging. The public infrastructure deployment plan is split into two phases - the first phase from 2021 to 2025 and the second from 2026 to 2030.

HRM Public Charging Infrastructure Plan



Phase 1

Timeline: 2021-2025

Objective: Increase geographical coverage across the Halifax region in both urban, suburban and rural areas

DCFC Ports: 16
Level 2 Ports: 336

Phase 2

Timeline: 2026-2030

Objective: Fill remaining gaps and add charging capacity where needed as adoption grows

DCFC Ports: 52
Level 2 Ports: 650

In both Phase 1 and Phase 2, the North End and South End of the urban core require the most L2 charging to accommodate for high levels of both off-street and on-street parking. Dartmouth and Bedford require the second highest L2 charging to accommodate for high levels of MURBs and workplace charging. Figure 8 shows the total number of L2 ports and DCFC ports needed for both phases.

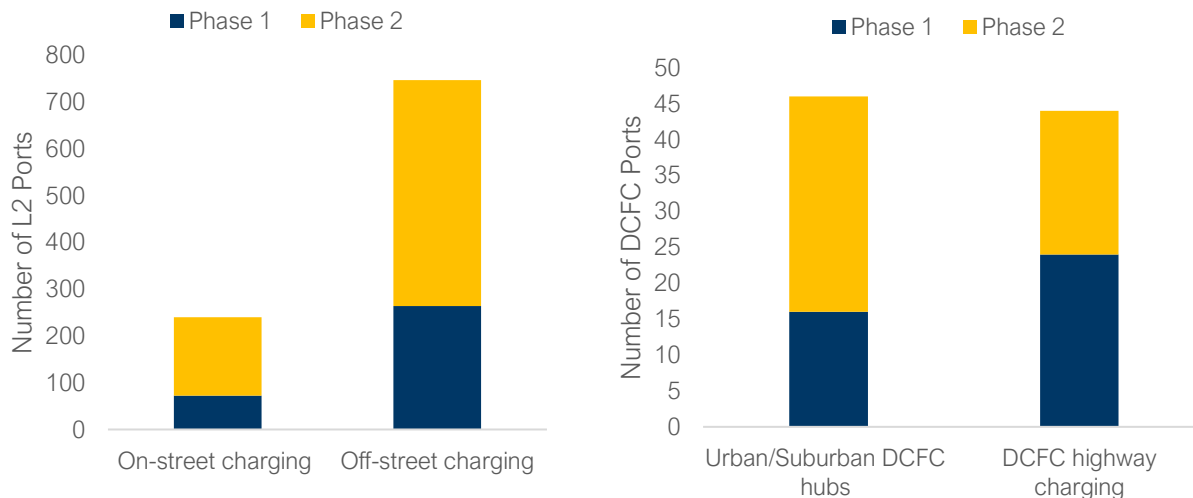


Figure 8 — Additional L2 Ports (left) and additional DCFC ports (right)

Phase 1 has a lower installation rate than Phase 2 to account for ramp up in adoption and to allow time for monitoring and assessment. In Phase 1, the majority of deployed L2 charging should be off-street parking (approximately 80%), which will play a more critical role than on-street charging in early adoption. The remaining 20% of ports should be installed on residential streets where there are residents who rely on on-street parking and where the street configuration facilitates curbside installations. With no current DCFC highway charging available, Phase 1 looks to deploy eight sites to increase geographic coverage across the Halifax region. The plan details the level of public charging infrastructure needed to reduce adoption

barriers and support the EV population forecasted by 2030. Table 7 outlines the phased plan in more detail.

Table 7 — Details of the phased Public Charging Infrastructure Plan for HRM

Phase 1		L2 Sites	L2 Ports/Site	L2 Ports	DCFC Sites	DCFC Ports/Site	DCFC Ports	# of EVs
1	Urban/Suburban DCFC hubs	0	0	0	8	2	16	13,314
2	DCFC highway charging	0	0	0	8	3	24	
3	On street L2 charging	12	6	72	0	0	0	
4	Off-street L2 charging	30	6 or 12	264	0	0	0	
Phase 1 Total		42		336	16	2 to 3	40	
Phase 2		L2 Sites	L2 Ports/Site	L2 Ports	DCFC Sites	DCFC Ports/Site	DCFC Ports	# of EVs
1	Urban/Suburban DCFC hubs	0	0	0	0	add 4 ports to existing sites.	32	64,578
2	DCFC highway charging	0	0	0	5	4	20	
3	On street L2 charging	28	6	168	0	0	0	
4	Off-street L2 charging	43	6 or 20	482	0	0	0	
Phase 2 Total		71		650	5	4	52	
Overall Plan		113		986	21	2 to 4	92	

As shown in Figure 9 below, the plan includes highway charging sites with greater geographic range with 3-4 ports per site, a sufficient port-to-site ratio to ensure that drivers will have access to a free port. In the more populated urban/suburban areas, DCFC sites are located in 8 neighbourhoods so that everyone is within a five-minute drive of a DCFC site. The urban/suburban DCFC sites initially have 2 ports per site in Phase 1 for early adopters and increase the port-to-site ratio to a total of 6 ports per site in Phase 2. As the sites already provide good geographic coverage, Phase 2 focuses on increasing ports as adoption grows. In all cases, sites should be future-proofed to minimize the cost of future expansions to add additional ports.

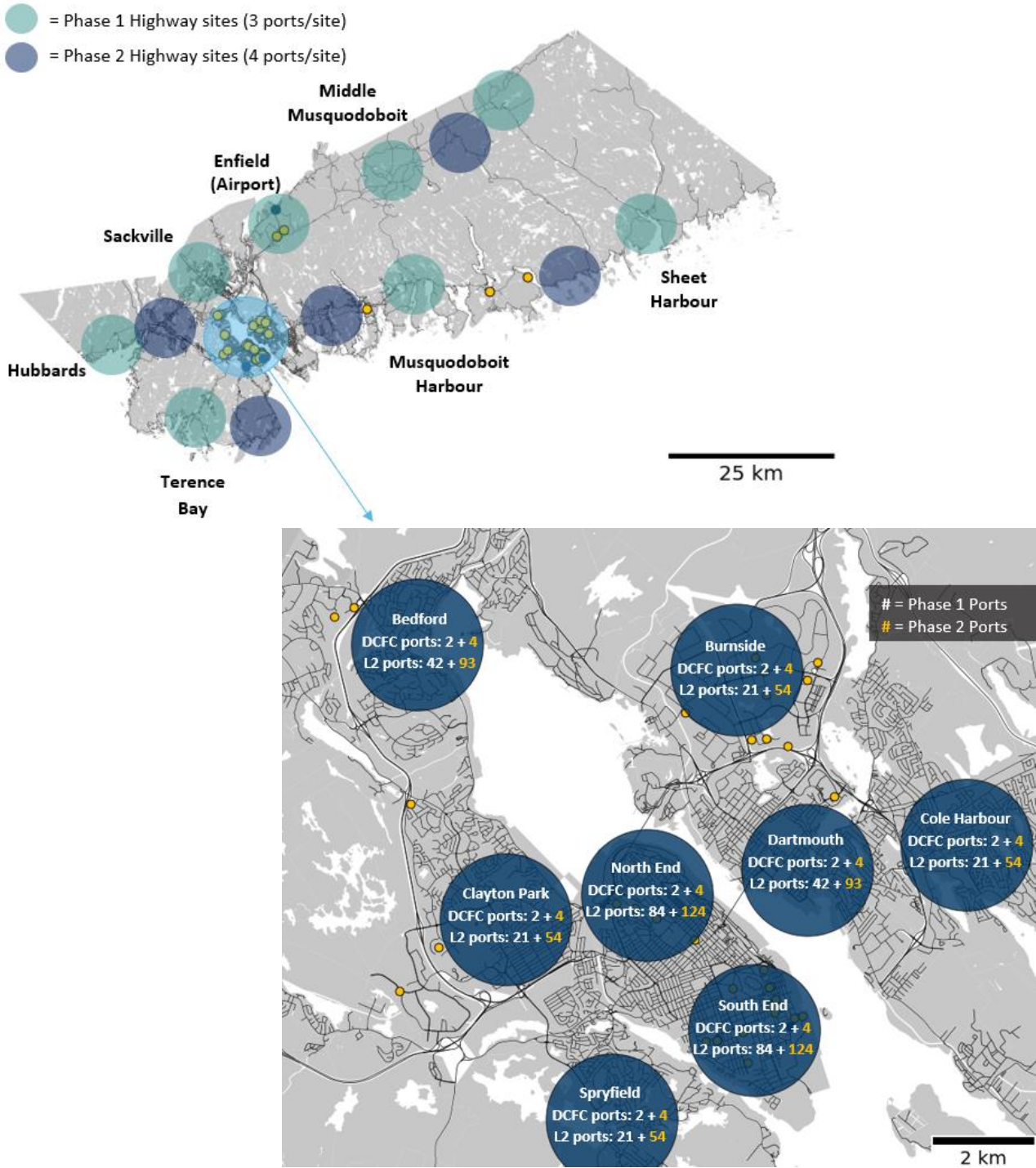


Figure 9 — Geographic distribution of chargers for phase 1 and 2

Key Public Charging Infrastructure Plan highlights include:

- Installing over 100 DCFC ports and around 1,000 L2 ports.
- Increasing geographic coverage in over 20 areas (8 in the urban/suburban core, and 13 in the greater Halifax region)
- Outlining the needed L2 and DCFC charging to support goal that 30% of all new vehicle sales are EV by 2030. Under this scenario there will be approximately 6000 EVs on the road in the Halifax region by 2025 and 29,000 EVs by 2030.
- Additional public infrastructure deployment would be needed to support the goal that 100% of all new vehicle sales are EV by 2030. It would require approximately 3500 L2 ports and 330 DCFC ports to be deployed by 2030. Under this more ambitious scenario there will be a total of 200,000 EVs on the road in all of Nova Scotia by 2030 and roughly 90,000 EVs on the road in the Halifax region by 2030.

2.5.3 – Cost Considerations

The capital cost estimate of the public charging infrastructure plan is around \$23 million. Table 8 outlines the cost breakdown for Phase 1 and Phase 2 per charging category. DCFC infrastructure costs dominate the overall costs. While off-street charging has a higher level of deployment than on-street (80% of ports in Phase 1 are off-street) the cost estimates of the two segments are roughly the same. This is attributed to the higher cost of on-street charging, which is roughly three times as much as off-street parking¹⁶.

Table 8 — Cost estimates of Phase 1 and Phase 2

Scenario: 30% EV Sales by 2030			
Phase	L2		DCFC
	On-street	Off-street	
Phase 1 (2021-2025)	\$1,080,000	\$1,320,000	\$7,800,000
Phase 2 (2025-2030)	\$2,520,000	\$2,410,000	\$7,850,000
Totals	\$3,600,000	\$3,730,000	\$15,650,000
Program Total	~\$23,000,000		

While this was not included in the detailed plan, we evaluated the level of infrastructure needed to support the projected EV population under 100% EV sales by 2030 scenario. The estimated capital cost for that scenario would increase the overall cost to \$80 million.

Table 9 — Cost estimate outline of 100% EV sales 2030

Scenario: 100% EV Sales by 2030			
Phase	L2		DCFC
	On-street	Off-street	
Totals	\$11,880,000	\$12,309,000	\$54,500,000
Program Total	~\$78,700,000		

2.5.4 – Potential Sites

The municipality provided a list of potential EV charging sites at municipal locations and several were chosen as high potential sites based on the following criteria:

Urban/Suburban DCFC hubs: Sites are near amenities where people tend to spend 15 – 45 minutes. This includes grocery stores, shopping centers, and food services. Sites should not be chosen where people typically spend longer periods of time as DCFC charging does not typically require more than 45 minutes. Locations such as movie theatres or parks are not ideal for DCFC sites.

¹⁶ This is mainly due to the higher cost associated with electrical infrastructure for on-street installations.

L2 off-street charging: Best suited at locations where people would leave their car parked for several hours, such as parks, rec centers, or movie theatres. This also includes central public parking lots that are used for park and ride or workplace parking. Private workplace parking lots are also included in this segment, but site location is dependant on the property owner.

Figure 10 shows a few examples of potential locations for deployment based on geographic coverage. We advise that this is a high-level example and site locations will depend on site conditions and will need to be determined on a case-by-case basis.

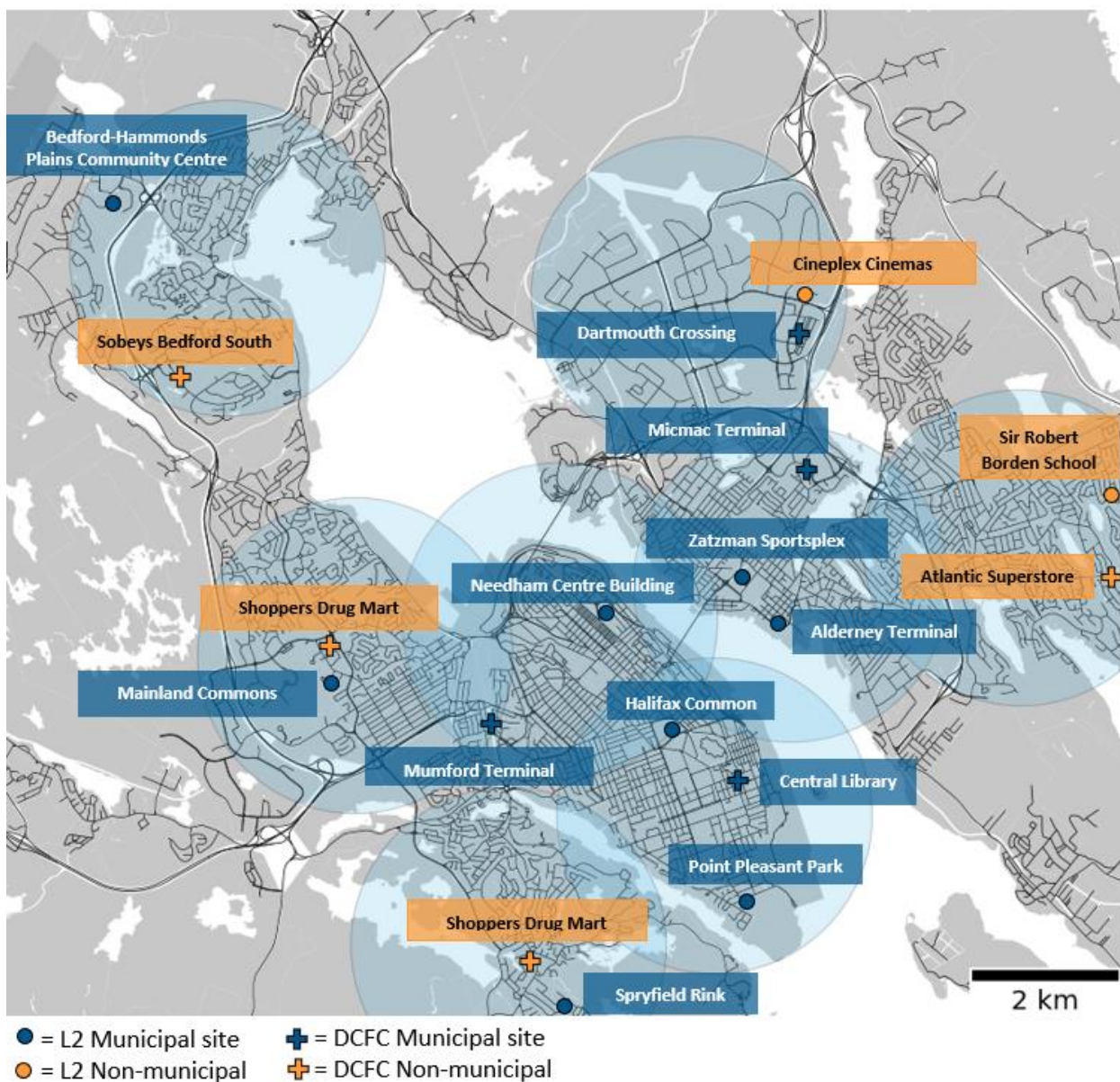


Figure 10 — Map showcasing some examples of charging locations

2.5.5 – Deployment Partnerships

There are different methods when it comes to HRM deploying EV charging infrastructure:

- **Own and operate:** This is when HRM pays the upfront costs to deploy and operate the charging sites. HRM can also retain ownership of the equipment while outsourcing the operation of the site to a third party. Generally, this is the deployment model that has been implemented by municipalities across North America.
- **Make Ready:** This is strictly a utility deployment model where the utility pays for and owns the electrical infrastructure on the site, leaving the site host to choose charging equipment that best fits their needs. HRM can work with NSPI to enable a make ready program.
- **Leasing:** HRM owns the charging infrastructure but a third party agrees to rent the site for a period of time.

With a lack of a business case at this stage for private investment in public infrastructure and NSPI unable to make further investments without regulatory approval, HRM should play an immediate active role in deployment of charging infrastructure while advocating for regulatory change that can allow greater support from the electric utility. If NSPI is given approval in the future to either deploy infrastructure directly or provide incentives, this will reduce the pressure on HRM to be the sole actor in this area. Likewise, as EV adoption increases and the economics of operating charging infrastructure improve, HRM can either continue deployment with a more attractive business case or support a transition towards third party ownership of charging sites.

2.5.6 – Funding opportunities

As highlighted above, the level of investment that will be needed from HRM will be dependent on the evolution of the market and the level of engagement from market players in public charging infrastructure. However, there are existing and potential funding opportunities that HRM can leverage to reduce its overall cost of deployment. Funding sources include:

- Natural Resource Canada's Zero Emission Vehicle Infrastructure Program (ZEVIP) is specifically designed to deploy zero-emission vehicle charging (L2 and higher) where Canadians live, work and play. The program targets multiple streams like public places, on-street, workplaces, and light-duty vehicle fleets. The program releases multiple requests for proposals each year focusing on one or several streams at a time. HRM should continuously monitor the program to ensure no funding opportunities are missed.
- Natural Resource Canada's Electric Vehicle and Alternative Fuel Infrastructure Deployment Initiative aims to establish a coast-to-coast network of fast-charging stations along the national highway systems. Given the wide-spread geography of the Halifax region, HRM can leverage this program to cover a portion of the deployment costs for highway fast charging.
- The Federation of Canadian Municipalities Green Municipal Fund (GMF) provides municipalities funding to switch to innovative and sustainable practices, faster. There is a precedent where the GMF was used to fund charging infrastructure as part of innovative mobility solutions. HRM should consider leveraging the fund to cover a portion of charging infrastructure deployment costs in urban centres.

- The Investing in Canada Infrastructure Program (ICIP) has a funding stream dedicated for green infrastructure which includes EV charging.

2.5.7 – Monitoring and Adapting

Phase 2 deployment can benefit from the learnings of Phase 1. EV adoption rates, forecasts and site usage should be monitored on a semi-annual or annual basis to shift Phase 2 plans appropriately. Utilization of existing charging sites can help inform which sites would benefit from expansion, and more broadly, which types of infrastructure have been most successful in supporting adoption. Residents without access to charging at home may gravitate towards either using nearby on-street L2 infrastructure or may instead use a nearby fast charger roughly once a week. Usage data from existing stations can help to understand whether one type of infrastructure is in higher demand and worthy of higher levels of investment.

L2 on-street charging should be monitored closely as usage levels can help determine the streets and neighbourhoods that are most reliant on the infrastructure. Further analysis is needed to fully determine the role of curbside charging in phase 2. A larger analysis of housing data is needed, specifically the number of homes and streets with no driveways/garages. Also, the number of MURB EV charging retrofits will have a significant impact on the level of on-street charging that will be necessary in Phase 2.

That said, utilization should not be the only metric of success for all types of charging infrastructure. DCFC sites can have an outsized impact on encouraging EV adoption by providing a level of reassurance with the possibility of a quick top-up, even if ultimately this reassurance is only put to use on occasion. Usage data analysis can be complemented with user and general population surveys to gain a better understanding of the degree to which infrastructure investments are having an impact.

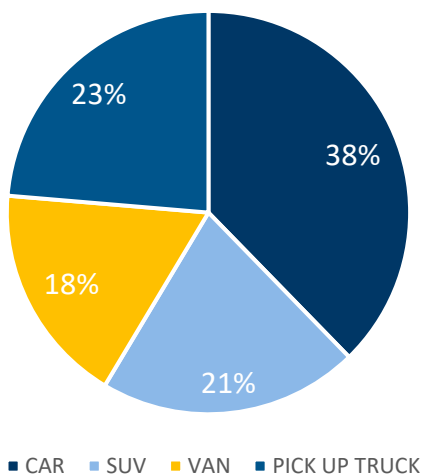
3. Fleet Electrification

3.1 – Context

The primary objective of this component of the strategy is to develop clear recommendations for the least disruptive light-duty fleet transition pathway. HalifACT includes a commitment to achieve net-zero municipal operations by 2030, which includes electrifying 100% of corporate fleet vehicles.

The current corporate fleet consists of 541 light-duty vehicles with cars (e.g. hatchbacks, sedans) making up almost 40% of the fleet composition. The second largest segment is pick-up trucks, making up almost a quarter of the total fleet. The pick-up truck segment also has the highest maximum average daily kilometers driven, as shown in Figure 11. The maximum daily kilometers driven highlights that, on average, **all vehicles in the fleet would be able to cover the required maximum daily distance within the range of a typical EV (300-400 km)** in each of the respective vehicle segments. It should be noted that some fleet vehicles will also be idling for significant amounts of time which can influence the range of the vehicles. However, electric vehicles offer additional benefits in terms of cost savings for vehicles with high idling time.

Fleet Composition by Vehicle Segment



Maximum Average Daily Kilometers Driven

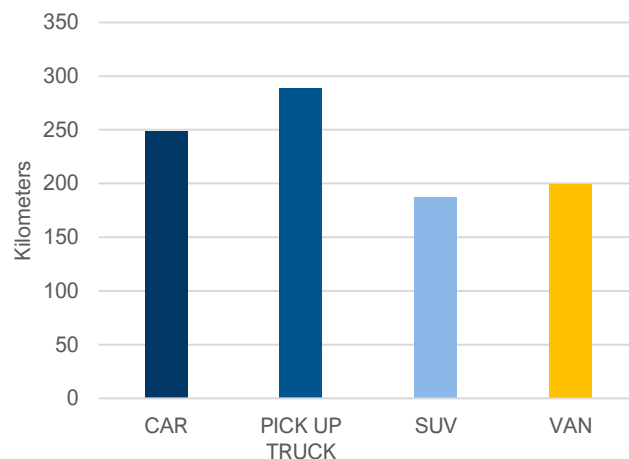


Figure 11— Left: Fleet composition by vehicle segment. Right: Maximum average daily kilometers driven by vehicle segment

3.2 – Methodology

Dunsky's Fleet Electrification Optimization model was used to determine the most optimal pathway for electrification of the corporate fleet. The most optimal pathway will achieve electrification in the most cost-effective way, while meeting the requirements of the fleet and minimizing disruption to operations.

Specifically, the model includes the following:

- **Total Cost of Ownership (TCO):** includes upfront cost, maintenance cost, fuel and electricity costs, carbon tax rates.
- **Dunsky’s EV Availability Timeline:** includes a list of announced and anticipated vehicles for both BEVs and PHEVs.
- **Dunsky’s EV Price Forecast:** includes the cost of vehicle replacements for ICE, BEV and PHEV from 2020 to 2030 for all vehicle segments.
- **Fleet Optimization Algorithm:** determines the optimal year for vehicle replacement in order to achieve the EV fleet composition set target (i.e. 100% by 2030 for HRM)

3.3 – Fleet Electrification Plan

3.3.1 – Scenarios

To assess the economic and GHG impact of the electrification plan, two scenarios that reflect different levels of electrification were developed as shown in Table 10. The business as usual (BAU) scenario represents the status-quo assuming the continued use of gas-powered vehicles. The Optimal Electrification Plan (OEP) scenario includes the 100% by 2030 target with option for early replacements of vehicles before 2030 in cases where there is an economic advantage.

Table 10 — Scenarios for the Fleet Electrification Plan

	Business as Usual (BAU)	Optimal Electrification Plan (OEP)
Electrification Target	0%	100% by 2030
Planned Retirement Threshold	15 years or 400,000 km	15 years or 400,000 km
Early Retirement	N/A	Optimal year

3.3.2 – Fleet Electrification Roadmap

The fleet electrification roadmap presents a detailed yearly plan that includes the specific numbers of vehicles electrified, vehicle types (e.g. SUV, car), and powertrain technology (BEV, PHEV) for every year. Figure 12 highlights the numbers of EVs added to the fleet by vehicle type per year from 2020 to 2030. During the first two years we set a ten percent replacement limit that was applied to reduce disruption to operations and gradually introduce EVs into the fleet.

In 2023, the replacement limit is increased, specifically in the car and SUV segments. In 2025, there is a significant increase in pick-up truck EVs which is due to the anticipated availability of these vehicles during that year, which will unlock the electrification potential for that vehicle segment. A significant proportion of the fleet (i.e. 75%) is replaced within the first five years of the study period as shown in Figure 13. Given that the model only recommends early replacement based on an advantageous economic case versus the status quo, this is an indication of the positive business case for EVs despite their higher capital cost.

Table 11 highlights the fleet electrification roadmap by vehicle type and powertrain technology. It should be noted that all the vehicles that were recommended to be electrified to PHEVs would operate 97% of the time in electric mode. This means that on average, these vehicles will use the gas engine component of the vehicle only 3% of the time. Generally, this is due to the vehicle's average daily kilometers being within the all-electric range for the recommended PHEVs. These vehicles will take advantage of the vast majority of operational (fuel savings, maintenance) and emission reduction benefits, with a lower incremental cost. It should be noted however that the price of PHEVs is forecasted to exceed that of BEVs later in the decade, hence why we do not see PHEV adoption in the later years of the study period.

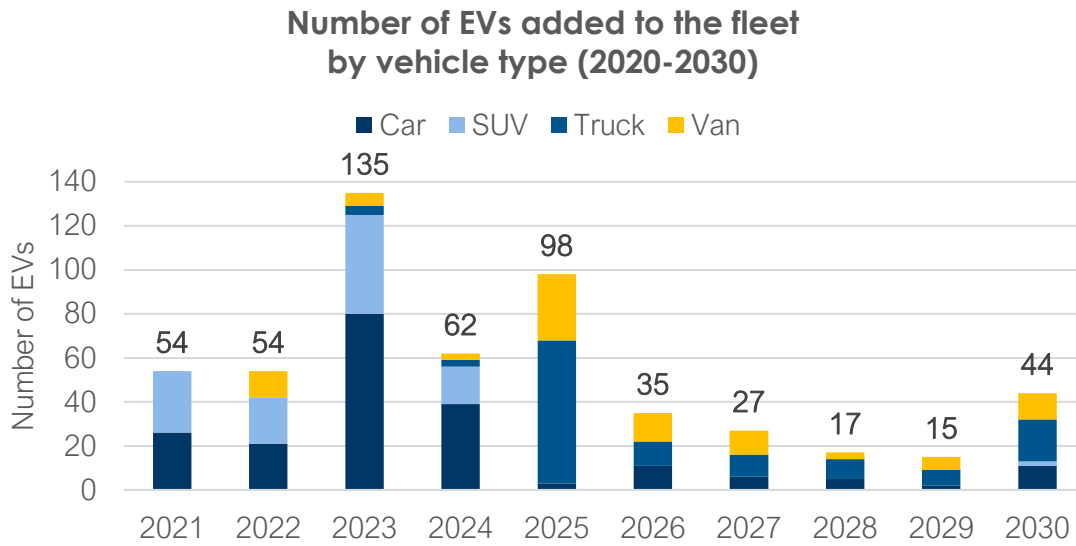


Figure 12 — Fleet electrification roadmap by vehicle segment

Proportion of EVs vs ICE Vehicles in the Fleet (2020 -2030)

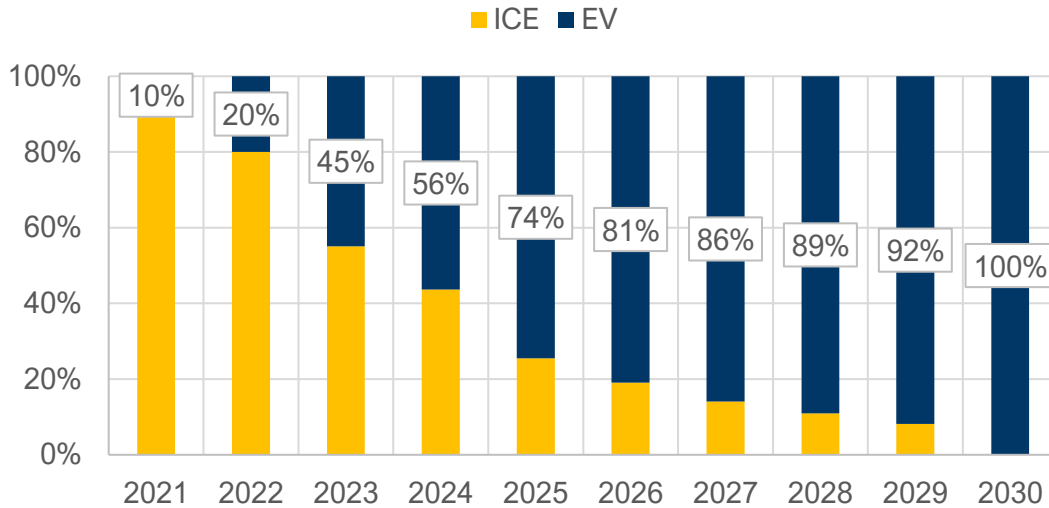


Figure 13 — Proportion of EVs vs. ICE vehicles in the fleet (2021 – 2030)

Table 11—Fleet electrification roadmap by vehicle segment and powertrain type

Vehicle Type	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
CAR	26	21	80	39	3	11	6	5	2	11	204
BEV	23	16	17	3	3	11	6	5	2	11	97
PHEV	3	5	63	36	-	-	-	-	-	-	107
PICK UP TRUCK			4	3	65	11	10	9	7	19	128
BEV			4	3	65	11	10	9	7	19	128
SUV	28	21	45	17						2	113
BEV	9	1	3	3	-	-	-	-	-	2	18
PHEV	19	20	42	14	-	-	-	-	-	-	95
VAN		12	6	3	30	13	11	3	6	12	96
BEV		11	6	3	30	13	11	3	6	12	95
PHEV		1	-	-	-	-	-	-	-	-	1
Total	54	54	135	62	98	35	27	17	15	44	541
BEV	32	28	30	12	98	35	27	17	15	44	
PHEV	22	26	105	50							

Figure 14 shows the annual fleet GHG emissions of the BAU versus the OEP scenario. To estimate the overall GHGs we used the most up-to-date grid intensity projections by NSPI. The decline in GHGs in the OEP scenario is due to the increased EV proportion in the fleet alongside the decarbonization of the grid planned by NSPI (2020 forecast). This annual emission reduction may be greater by 2030 as the current Provincial government recently announced a target of 80% renewable electricity by 2030. HalifACT identified that the ability to reduce emissions and achieve net-zero emissions by 2050 is largely dependent upon the decarbonization of the provincial electricity grid. Essentially, a 100% clean energy supply is a baseline condition to reaching carbon neutrality.

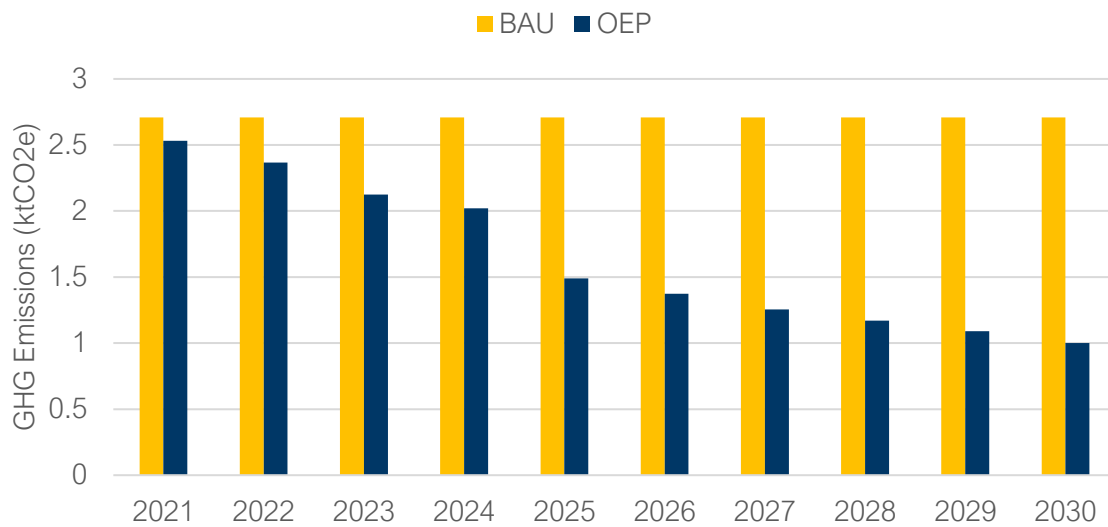


Figure 14 — Annual fleet GHG emissions of BAU vs. OEP

Figure 15 shows the cumulative GHG savings for the OEP versus BAU scenario. Overall, the OEP scenario results in significant GHG reductions, with over 10 ktCO₂e or a 40% reduction relative to the BAU scenario. If the HRM is able to significantly expand local community-scale renewable energy generation as recommended in HalifACT, the cumulative GHG savings could be more favourable (around 80-90% over the next 10 years).

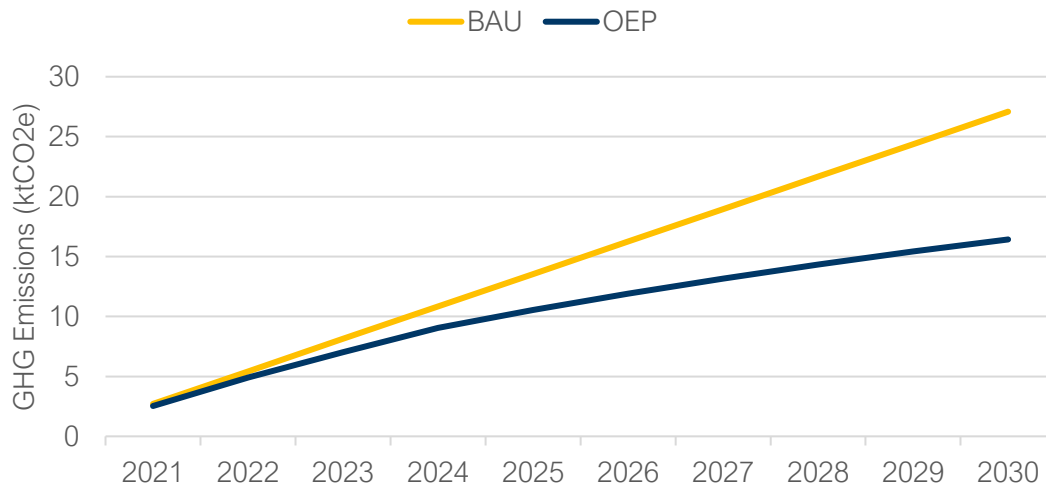


Figure 15 — Cumulative GHG emissions of BAU vs. OEP scenarios

3.3.3 – Charging Infrastructure Requirements

The fleet’s transition to EVs will introduce a new component to fleet operations: charging infrastructure. The number of chargers (*i.e.* ports) required is simply correlated with the number of vehicles in order to simplify operations and ensure that each vehicle is able to charge after use. However, there are several suitable options for electrical configurations that can help reduce installation costs and optimize the performance of the chargers to minimize the impact on the building’s electrical operations (*i.e.* demand charges).

The most notable options for electric vehicle service equipment (EVSE) configurations include dedicated circuits and circuit sharing. Dedicated circuits require significant electrical system infrastructure to accommodate the electrical load and generally have no interaction with other EVSE. Circuit sharing (*i.e.* power sharing) is defined by multiple EVSE being supplied from a single circuit with demand control to ensure circuit rating is not exceeded. Figure 16 highlights the high potential for four way sharing within the fleet. Given the average kilometers driven by the vehicles, the vast majority of the fleet will be capable of power sharing, which will reduce installation costs significantly.

Power sharing makes it possible for fleets to meet driver demand and charge more EVs without making major infrastructure updates.

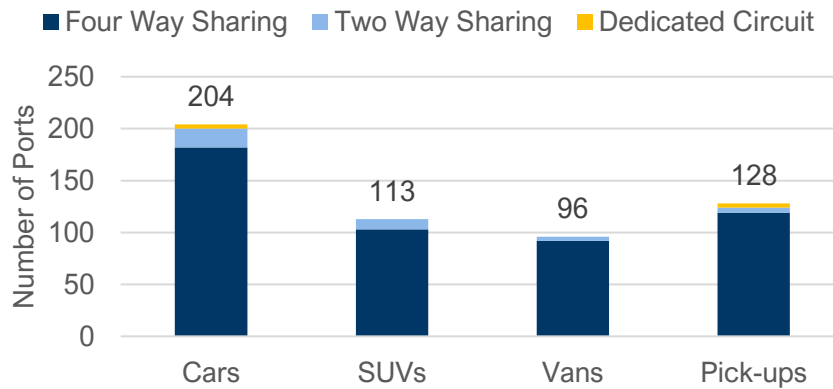


Figure 16 — Number of EVSE needed for the fleet with potential for circuit sharing

Figure 17 shows a comparison of the total cost of hardware and installation of EV chargers under a power sharing strategy versus no power sharing. Power sharing can reduce installation cost by 36%, or approximately one million dollars. There are many options for power sharing, however the simplest option would be to implement an equal split between chargers.

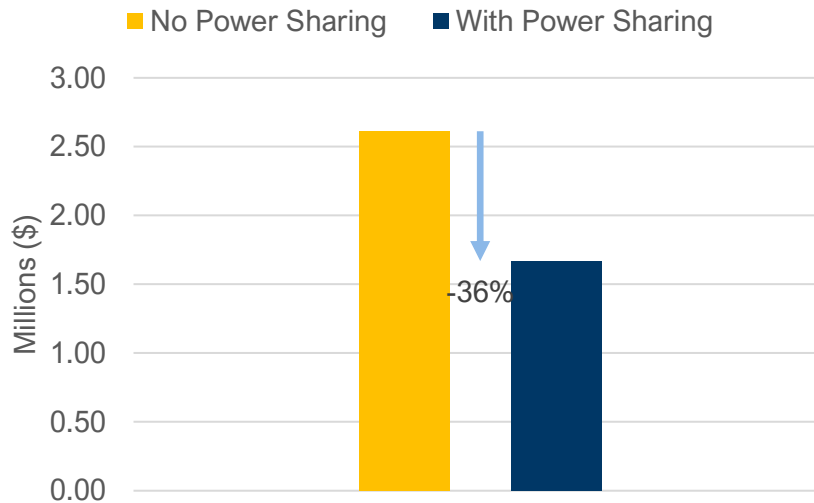


Figure 17 — Installation cost of electrical vehicle service equipment with and without power sharing

3.3.4 – Cost Considerations

While EVs are typically going to cost more upfront than a conventional vehicle in the near term, significant cost savings can be captured from reduced maintenance and fuel costs. Overall maintenance cost for an EV is far lower (around 25-50% of the cost for gas vehicles) due to fewer moving parts, fewer fluids, less wear on the brakes due to regenerative braking, and only minimal maintenance required for the battery, electric powertrain, and electronics. For example, New York City¹⁷ examined the maintenance costs for BEVs in its fleet and found that they were around 25% of the total costs of their gas counterparts. One concern that is often flagged when considering maintenance costs is regarding battery degradation. However, recent data¹⁸ shows that batteries are likely to outlast the usable life of the vehicle itself. **The savings on maintenance, fuel and the higher resale value well-position EVs from a cost perspective.**

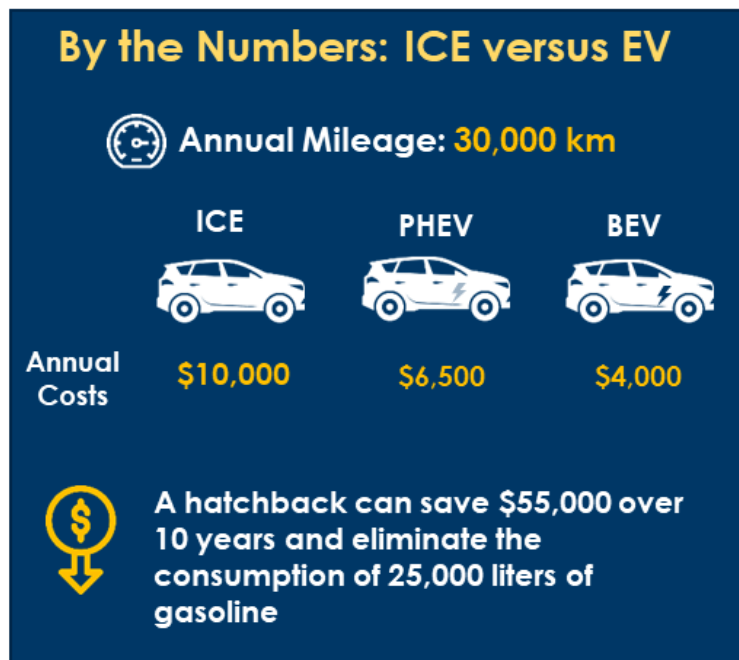


Figure 18 shows the total annual cost for the BAU scenario versus the OEP scenario. The total annual costs for the BAU scenario are dominated by operation costs (maintenance and fuel), while the costs for EVs are dominated by upfront purchase costs. In the earlier years, when the fleet is transitioning and early replacement of gas cars is taking place, the OEP scenario shows a higher annual cost. However, later years show a lower cost for the OEP scenario due to the high savings on operations and the lower proportion of early retirement.

Figure 19 shows the discounted net cash flow (5%) for the cost/benefits of the OEP scenario relative to the BAU scenario. Initially, the cash flow is negative due to high replacement rates in the first five years. However, in later years, the cost benefits of EVs start to materialize and result in a positive cash flow. Figure 20 shows a sensitivity analysis of the net present value (NPV) relative to the discount rate. The analysis highlights that even with a high discount rate (5%), the NPV remains around zero, indicating that **the fleet can achieve its zero emissions target without any significant incremental cost.**

¹⁷ <https://www.government-fleet.com/327215/nyc-compares-maintenance-costs-for-ev-and-gasoline-vehicles>

¹⁸ <https://www.geotab.com/press-release/ev-battery-degradation-tool/>

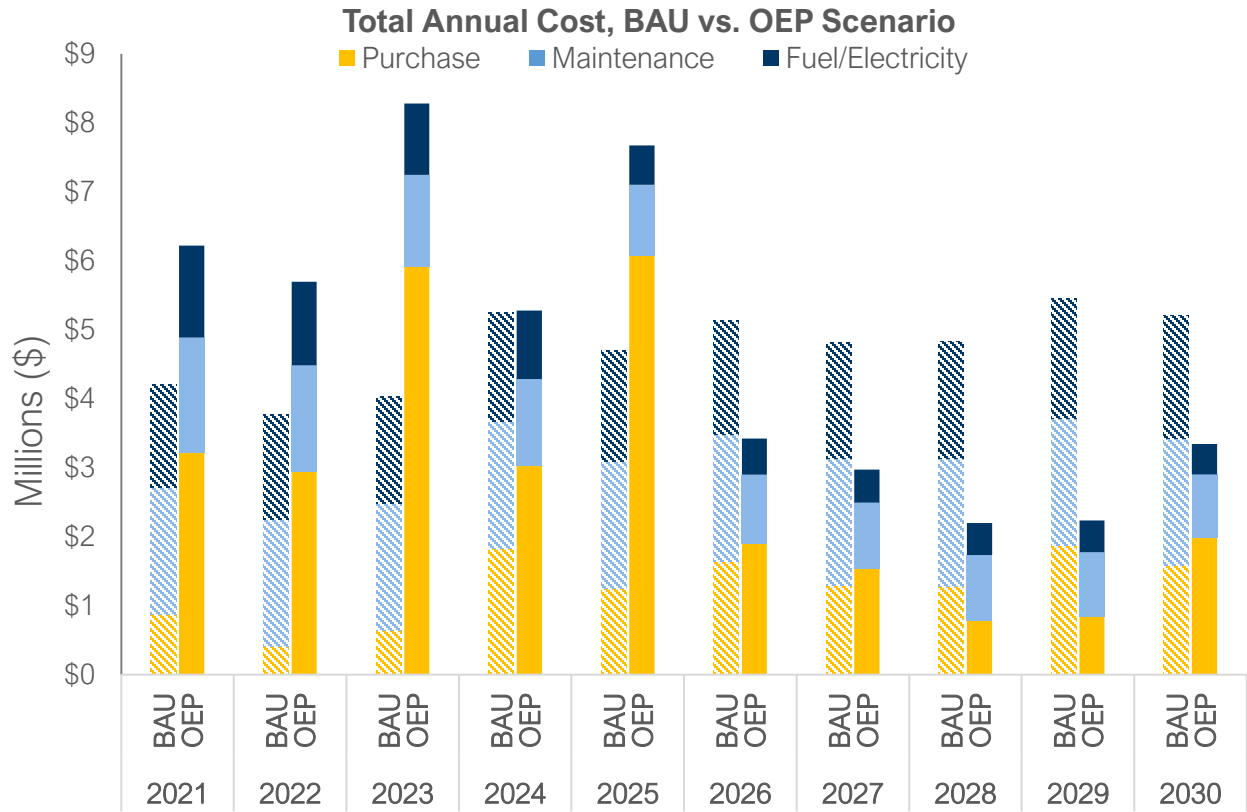


Figure 18 — Total annual cost for BAU and OEP scenarios

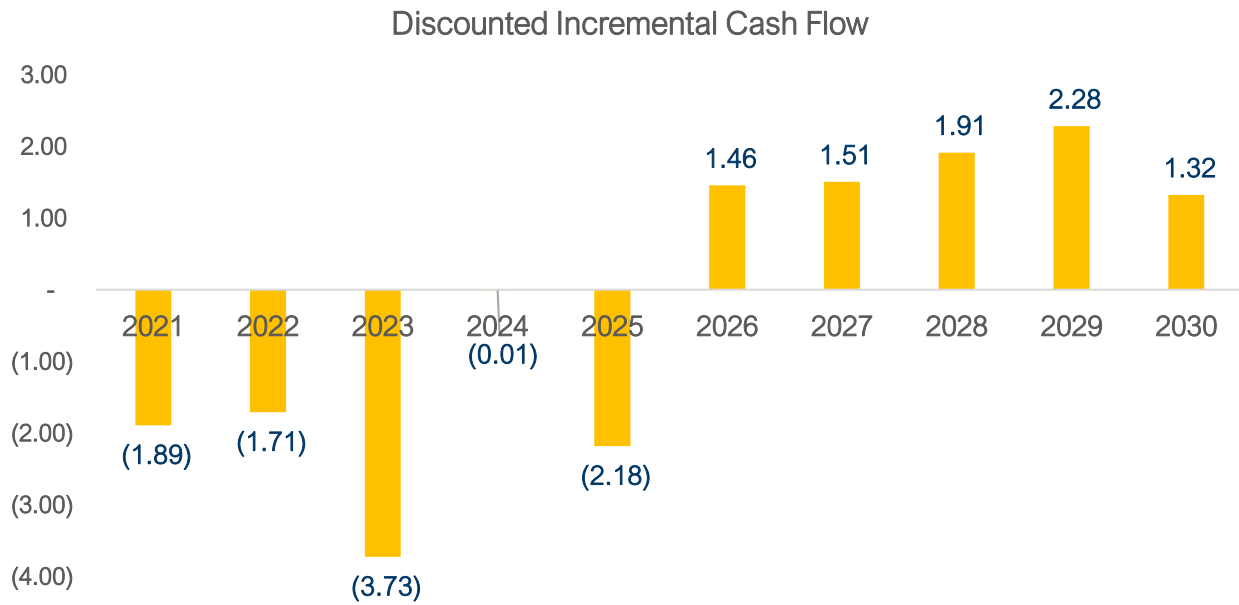


Figure 19 — Discounted incremental cash flow for the OEP scenario

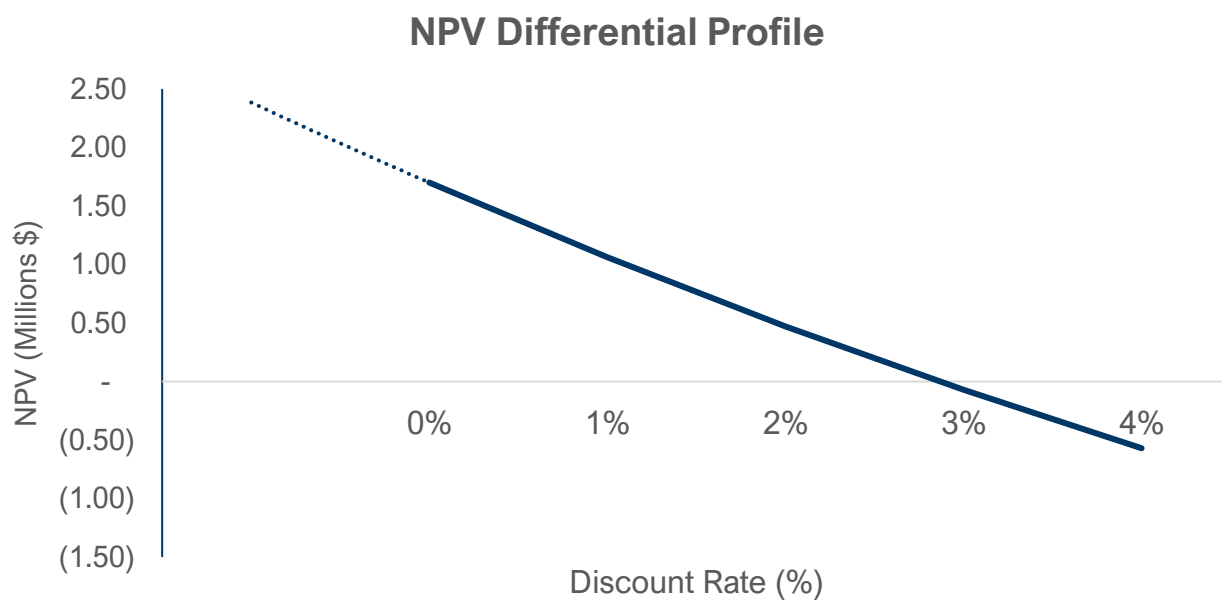


Figure 20 — NPV Difference between OEP and BAU as a function of discount rate

3.3.5 – Operational Considerations

As highlighted earlier, introducing EVs to the fleet will offer several benefits; however, proper planning will be required to ensure minimal disruption to the fleet operations. The following should be considered:

- Hire personnel dedicated to planning and overseeing the fleet transition.
- Provide comprehensive training to staff to familiarize them with both the vehicles as well as the charging infrastructure¹⁹.
- Maintain in-house technicians to conduct routine maintenance on the vehicles (e.g. brakes, tires).
- Leverage the dealerships or a third party for more complex maintenance on the electric powertrain (i.e. high voltage system).
- Ensure ongoing maintenance and support for the EV charging equipment.
- Implement active load management to help better manage demand charges and reduce cost.

¹⁹ This can be done by leveraging organizations involved in public education and awareness regarding EVs (i.e. NextRide Campaign).

4. Municipal EV Policies

Local governments can play a significant role in accelerating adoption by implementing and advocating other levels of government for a range of policies. As highlighted earlier, public charging infrastructure is an important area where the municipality can directly influence the market. However, while a portion of the market may be willing to use public or workplace charging as a substitute for charging at home, the ability to charge overnight and wake up to a full charge can help more mainstream consumers see EVs as a desirable alternative to gas car ownership. Therefore, access to charging at home is critical for maximizing the convenience of EV ownership. Some local governments are well-positioned to help maximize access to charging at home, both by setting requirements for new construction, and by encouraging retrofits of the existing building stock. Cities may also implement other policies that can help incentivize EV adoption. Some examples include, zero emission vehicle zones, on-street parking regulations, high occupancy vehicle (HOV) lanes and free access to toll bridges.

4.1 – EV Ready Requirements for New Construction

Lack of home charging, particularly in MURBs is one of the key barriers to adoption of EVs. Similarly, access to charging in other residential and commercial contexts can significantly support EV adoption.

While EV penetration in the Halifax region is low today, any new residential building constructed today is very likely to see a 100% EV penetration within its lifetime. Designing these buildings with EVs in mind will help ensure that residents can have access to charging and will accelerate adoption in MURBs. “EV ready” stalls feature an adjacent electrical outlet at the parking space with the ability to install EVSE in the future.



Local governments in BC now require 100% EV ready residential parking in new developments. Designing for 100% EV Ready parking in MURB condominiums is particularly important. Condominium parking tenure typically provides very limited opportunity to swap (i.e. trade) parking stalls. Under these circumstances, households without EV Ready parking will not be able to access EV charging in their assigned parking space.

Designing for 100% EV Ready parking is cost-effective when cities allow new developments to use EV Energy Management Systems (EVEMSs). EVEMSs are a type of technology that control EV loads – they allow for multiple EVs to charge on a given electrical circuit. This significantly reduces the total size of the electrical infrastructure that must be installed to make all parking EV Ready, and reduces cost. The cost of providing 100% EV Ready parking can be comparable to the cost of providing just 20% of parking on dedicated, unmanaged circuits (as several cities have previously required, such as the City of Toronto). For the reasons stated above, we recommend that HRM implements the following policies:

- **Require 100% EV ready parking in new residential construction (MURBs and single-family homes).**
- **Require 10-20% EV ready parking in non-residential buildings.**

4.1.1 – Policy Implementation

Based on preliminary discussions with HRM's legal team, implementation of the policies recommended above are in conflict with existing laws and regulations enacted by the Province such as the Building Code Act, Building Code Regulations, Electrical Installation and Inspection Act and Electrical Code Regulations. Therefore, it is recommended that HRM request a charter amendment from the Province of Nova Scotia to gain authority to mandate the requirement of electric vehicle supply equipment in new construction.

4.2 – EV Ready Retrofits in Existing Buildings

While requirements for new construction can help ensure that any new buildings are designed with EVs in mind, the existing building stock must also be addressed. To date, integration in existing MURBs, workplaces and fleets is minimal. Future-proofing parking with comprehensive EV Ready retrofits can lower life cycle cost and simplify future EVSE installations. For example, it can be about a fifth of the cost to retrofit all parking spaces to be EV ready at once than, upgrading a few stalls at a time. Moreover, it ensures households have immediate access to EV charging, whereas organizing incremental upgrades can be complicated and take many months. This is especially the case in condominiums, where decision-making and parking space swapping can be challenging.

Governments and utilities can help encourage building owners to take more comprehensive approaches to EV Readiness. For example, British Columbia recently launched an EV Ready Rebate Program²⁰, providing incentives to MURBs to implement comprehensive designs for 100% EV Ready buildings. This will be much lower cost on a life cycle basis than incrementally retrofitting MURBs a few parking spaces at a time to implement charging.

Given that penetration of EVs is currently low in the Halifax region, HRM should consider supporting both small scale retrofits to implement a few charging stations (which can be a first step or “foot in the door”, if a condominium is not ready for comprehensive upgrades) as well developing comprehensive retrofit programs. We recommend HRM implements the following policies:

- Offer a **retrofit program** for MURBs with a focus on rental properties to **promote more equitable access** to electric mobility options. Coordinate with the Province and NSPI to seek leveraged incentive funds.
- Develop a pilot program to provide buildings owners and condominiums support to develop an **EV Ready Plan** that will guide comprehensive 100% EV Ready retrofits. These studies can help build momentum and highlight the benefits of comprehensive retrofits over incremental ones.
- **Act as a delivery agent** to provide funding through NRCan's ZEVIP program and other future EV funding sources.

²⁰ [BC EV Ready Rebate Program](#)

5. Advocacy and Support

5.1 – Advocate for Sustained Financial Incentives

The higher upfront cost of EVs relative to Internal Combustion Engine Vehicles (ICEVs) remains one of the key barriers to EV adoption. While cost reduction trends are expected over the next decade, a cost forecast analysis recently conducted by Dunsky showed that price parity for medium-sized LDVs would likely be as far as 2030. In addition, our analysis showed that the total cost of ownership (TCO) breakeven point for an EV purchased in 2020 would be close to 10 years in the absence of financial incentives.

The use of financial incentives to encourage the adoption of EVs has proven to be an effective policy lever in overcoming these barriers across many jurisdictions. The market in Canada follows the same trend, with leading jurisdictions (QC, ON, BC) being ones that have implemented a provincial financial incentive. As highlighted earlier, incentives also seem to have long-term impacts, with Ontario remaining well ahead of other provinces even after the government stopped the incentives in 2018.

Stakeholders indicated that financial incentives would be a critical intervention in helping move the market forward in the province. Specifically, upfront purchase incentives were highlighted as most likely to directly address cost barriers from a consumer's perspective. While there are several other approaches to offering financial incentives, including tax credits and discounts on annual fees, studies have shown that upfront incentives are the most effective in influencing adoption by directly addressing the high upfront incremental cost of EVs.

The province of Nova Scotia recently announced upfront purchase incentives for new and used EVs (\$3,000 and \$2,000 respectively), as well as e-Bikes (\$500). **HRM should play a role in advocating for sustained funding for both provincial and federal purchase incentives and a gradual planned phase-out that ensures the affordability of EVs over the long-term**

5.2 – Advocate for a ZEV Mandate

While financial incentives, deployment of charging infrastructure, and awareness campaigns can be critical tools to help increase consumer demand for EVs, adoption can remain stifled by the lack of availability of EVs due to vehicle supply constraints. EV supply was identified as a major constraint in Nova Scotia by multiple stakeholders. Dunsky's own analysis found that 90% of dealerships in the province have no EVs available for purchase. Stakeholders identified several barriers to entry for dealerships looking to begin selling EVs, including training of sales staff and service technicians, and the cost of specialized tools and charging infrastructure. Also, multiple stakeholders indicated that automakers are prioritizing markets where they are mandated to sell EVs over Nova Scotia, with some dealerships struggling to receive inventory and putting customers on months-long waiting lists.

Many jurisdictions in North America have adopted the California ZEV standard, which requires automakers to sell a certain number of electric vehicles based on the overall vehicle sales in the province/state. The program works based on a credit system, where each EV sold earns a number of

credits based on the type of technology and its battery range. The automotive industry has traditionally pushed back against ZEV mandates citing them as a high burden on their business. However, recent developments seem to indicate otherwise, with GM calling for a National ZEV program and announcing a halt to ICEV production by 2035 (aligned with California’s newly announced mandate). Several states with a similar vehicle market size to Nova Scotia have successfully adopted a ZEV mandate (e.g. Maine, Rhode Island, Vermont). It is important to note that all ZEV states/provinces have also adopted demand-side policies (i.e. financial incentives). This ensures that proper steps are taken to ensure there is sufficient consumer demand to meet the mandated supply targets.

Several stakeholders in Nova Scotia indicated that the province would benefit significantly from the introduction of a ZEV mandate. A ZEV mandate would ensure that interested consumers could find EVs available for purchase in local automotive dealerships in sufficient supply to satisfy that demand. **HRM should advocate for a provincial ZEV mandate that is aligned with the leading jurisdictions in North America (e.g. Quebec, California)**

5.3 – Public Education

To address information barriers facing EVs, initiatives to educate and increase awareness of EVs can have a significant impact in accelerating adoption at relatively low cost. EV marketing and awareness campaigns, test drive events, and “leading by example” (e.g. electrification of government and utility fleets) can increase awareness of EVs by correcting misconceptions and addressing perceived barriers to adoption. Key components of an education and awareness plan include:

- EV Information (i.e. websites, FAQ, case studies)
- Campaigns/Active Marketing
- Test-and-drive events/showrooms
- Account manager engagements/advisory services

Recent education and awareness efforts through the **Clean Foundation’s “Next Ride”** initiative have been successful to date with more than 89 events, 1,200 test drives and 5,000 engagements, helping Nova Scotians discover the benefits of EVs. The Clean Foundation has also developed a web platform, **EV Assist²¹ Nova Scotia**, to provide information on EV basics, owning an EV, electric charging, and available infrastructure in Nova Scotia. NSPI houses an EV webpage that connects people with charging station maps, highlights EV benefits and provides information on EVs.

HRM should support the public education initiatives that are already underway, rather than duplicating efforts. HRM can offer resources like funding, staff time and EVs to partners already implementing EV awareness and education programs. HRM should first connect with organizations that are operating EV education programs and suggest a partnership.

²¹ <https://evassist.ca/>

As a partner, HRM can:

- **Share EV information:** Help spread awareness of events and information via social media and have an informational webpage directing the public to partner resources and events.
- **Share EVs and charging infrastructure for events:** Share branded fleet EVs with partners for test-and-drive and education events and offer a charging site location for educational field trips or events. Include educational signage at charging sites.
- **Offer municipal space:** Offer municipal sites or a simple method to book streets or city lots for test-and drive events and other education/awareness events.
- **Train staff and offer staffing resources:** Have staff trained on the benefits of EVs and have them help partners facilitate events and spread information.
- **Provide funding:** Help fund partner events or awareness initiatives across the Halifax region.

6. Strategy Map

HRM's EV Strategy is summarized in the following strategy map. Each action area is linked to specific recommended initiatives for HRM to act on. These outcomes are the result of local and best-practice research, a thoughtful stakeholder engagement process, and tailored modeling and analysis.

ACTION AREA	OPPORTUNITY AREA <i>To address barriers and enable adoption</i>	RECOMMENDED INITIATIVES <i>Actions designed to accelerate adoption</i>
Public Charging	<i>Deploy charging infrastructure</i>	<p>With lack of interest in private investment in charging infrastructure and no clear mandate for the utility to make these investments, there is an obvious gap for who will be deploying charging infrastructure within the city in the near term. HRM can play a crucial role in addressing these market failures by filling gaps in the public charging infrastructure landscape in the region</p> <ul style="list-style-type: none"> • Invest in public Level 2 on-street and in parking facilities <ul style="list-style-type: none"> ○ 2021-2025: 336 ports ○ 2026-2030: 650 ports • Invest in public DCFC hubs for urban/suburban areas as well as highways <ul style="list-style-type: none"> ○ 2021-2025: 40 ports ○ 2026-2030: 52 ports
Fleet Electrification	<i>Decarbonize Municipal Fleet</i>	<ul style="list-style-type: none"> • The optimal electrification plan developed for HRM enable the city to electrify 100% of its light duty vehicle fleet while reducing annual GHGs by more than 60% by 2030. This results in cumulative reduction of over 10 ktCO_{2e} in 10 years with little to no incremental cost to existing fleet operations despite the high rate of early replacements to EVs.
Municipal Policies	<i>New Buildings</i>	<ul style="list-style-type: none"> • Require 100% EV ready parking in new residential construction (MURBs and single-family homes). • Require 10-20% EV ready parking in non-residential buildings
	<i>Retrofit</i>	<ul style="list-style-type: none"> • Offer a retrofit program for MURBs with a focus on rental properties to promote more equitable access to electric mobility options. Coordinate with the Province and electrical utility to seek leveraged incentive funds. • Develop a pilot program to provide building owners and condominiums support to develop EV Ready Plans that will guide comprehensive 100% EV Ready retrofits. These studies can help building momentum and highlight the benefits of comprehensive retrofits over incremental ones. • Act as a delivery agent to provide funding through NRCan's ZEVIP program and other future EV funding sources.
Advocacy and Support	<i>Financial Incentives</i>	<ul style="list-style-type: none"> • HRM should play a role in advocating for sustained funding for both provincial and federal purchase incentives and a gradual planned phase-out that ensures the affordability of EVs over the long-term.

	<i>ZEV Mandate</i>	<ul style="list-style-type: none"> • HRM should advocate for a provincial ZEV mandate that is aligned with the leading jurisdictions in North America (e.g. Quebec, California)
	<i>Public Education</i>	<ul style="list-style-type: none"> • Share EV information: Help spread awareness of events and information via social media and have an informational webpage directing the public to partner resources and events. • Share EVs and charging infrastructure for events: Share branded fleet EVs with partners for test-and-drive and education events and offer a charging site location for educational field trips or events. Include educational signage at charging sites. • Offer municipal space: Offer municipal sites or a simple method to book streets or city lots for test-and drive events and other education/awareness events. • Train staff and offer staffing resources: Have staff trained on the benefits of EVs and have them help partners facilitate events and spread information. • Provide funding: Help fund partner events or awareness initiatives across the Halifax region.

Appendix A. List of Stakeholders

HRM Internal Team	Key Staff and Departments
<p>Parking Services</p> <p>Traffic Management</p> <p>Building Operations</p> <p>Corporate Fleet</p> <p>Legal Services</p>	<ul style="list-style-type: none"> • Victoria Horne, Manager Parking Services • Christopher Davis, Supervisor Right of Way Services • John Mason, Building Operations Manager • Scott Sears, Corporate Fleet Manager • Claire Gillivan, Municipal Solicitor
External Stakeholders	Main contact
<p>Nova Scotia Power Inc.</p> <p>Nova Scotia Department of Energy and Mines</p> <p>Clean Foundation</p> <p>Steele Auto Group</p> <p>Ecology Action Centre</p> <p>Electric Vehicle Association of Atlantic Canada</p>	<ul style="list-style-type: none"> • Sanjeev Pushkarna, Sr. Program Manager, Smart Grid Nova Scotia • Krista Phillips, Clean Energy and Transportation Strategist • Jeremie Bernardin, Clean Transportation Program Manager • Peter Porteous, VP Business Development • Kelsey Lane, Sustainable Transportation Coordinator • Kurt Sampson, Chair

Appendix B. EVA Methodology

The study uses Dunsky’s Electric Vehicle Adoption (EVA) Model. The EVA Model was developed to address a growing need by utilities and governments to understand the potential size of the EV market in their respective jurisdictions and corresponding impacts. Based on rigorous data, EVA leverages the modeling framework behind Dunsky’s proven Solar Adoption Model, and builds on the knowledge base and expertise of our mobility practice. EVA projects market demand for EVs based on several key factors.



Technical potential: The theoretical potential for deployment based on size (annual sales and fleet size) and vehicle class (e.g. cars, SUVs, trucks, buses) of the local vehicle market as well as the availability of different powertrain types (i.e. BEV, PHEV) for each vehicle class.

Customer economics: The unconstrained economic potential based on the Total Cost of Ownership (TCO) of EVs and ICEVs. The TCO calculation considers the incremental upfront vehicle cost, fuel costs, as well as operations and maintenance (O&M) costs over the vehicle’s lifetime.

Constrained potential: EV-specific barriers to adoption, including range requirements, range anxiety, home charging access, and public infrastructure deployment²² (Level 2 and DCFC).

Supply-side Constraints: Dunsky developed a proprietary tool to scan dealerships for local availability of EV models. EVA leverages this data to apply a constraint on the accessible market potential. This allows for modeling of various scenarios, including a supply-side mandate.

Market dynamics: Coupling technology diffusion theory with local market data to determine the rate of adoption of EVs locally, as well as competition between vehicle types.

The following approach was used in the study to forecast EV adoption in Nova Scotia:

1. **Market Segmentation and Characterization:** The LDV market was broken down into three representative segments, cars, SUVs, and trucks, that capture differences in vehicle costs, usage patterns, and EV model availability, among other factors.
2. **Model Calibration:** Using historical data on vehicle sales, costs and other parameters, EVA was benchmarked to historical EV sales in Nova Scotia (2012 – 2019), and key model parameters were calibrated to capture local market characteristics.
3. **Key inputs and assumptions:** For each vehicle segment, assumptions on average vehicle characteristics (fuel consumption, powertrain size, battery size, etc.) are used to develop a representative model of vehicles within the segment. Additional assumptions on utilization (e.g. distance traveled) and operational costs were also compiled and used to calculate a bottom-up vehicle cost and TCO for the different powertrains within each vehicle segment.

The following sources were used for Nova Scotia-specific inputs:

- Statistics Canada: population, area of population centers, and housing composition.
 - Nova Scotia Power Inc.: electricity rates
 - NRCan Comprehensive Energy Use Database: number of vehicles, annual vehicle sales, and fuel prices.
 - NRCan Electric Charging and Alternative Fueling Stations Locator: charging station deployment.
4. **Vehicle Cost:** For each vehicle class (i.e. car, truck, SUV) and drivetrain (i.e. ICE, BEV, PHEV) combination, the model develops a representative vehicle archetype to forecast EV adoption. A bottom-up vehicle cost is calculated for each vehicle type using data from Dunsky's internal database on typical vehicle characteristics for each segment (baseline vehicle cost, powertrain size and cost, vehicle efficiency, battery size and cost, etc.). The bottom-up estimates are then compared to actual vehicle

²² In considering charging infrastructure barriers in a jurisdiction, the EVA model considers regional coverage (geographic coverage of public charging infrastructure based of highway lengths and number of population centers that require coverage), local availability (a measure of the capacity of charging infrastructure required to handle local demand for charging by EVs – captured through an EV/port ratio for Level 2 and DCFC), and charging time (a measure of the average charging time installed public charging infrastructure in a jurisdiction can provide)

models of similar characteristics on the market to validate accuracy on estimates. Future vehicle costs are calculated using the same approach by varying battery costs and other key time-dependent factors.

5. **Vehicle Availability:** Using Dunsky's proprietary tool, we scanned the local availability of EV models across dealerships in Nova Scotia. The compiled data is used to determine the achievable market potential based on data from other jurisdictions with different levels of supply constraints. This is then used to forecast EV adoption in Nova Scotia under current constraints as well as considering increased availability in dealerships under natural market evolution and supply-side policies.
6. **Scenario Analysis:** Using Nova Scotia-specific data complemented with national data and other assumptions based on Dunsky's professional judgment and experience from other jurisdictions, we use the calibrated model to forecast future EV adoption in Nova Scotia. Specifically, the analysis considers adoption under various scenarios reflecting different interventions and policies (e.g. purchase incentives, ZEV mandates) as well as market and technology uncertainties (e.g. electricity rates, battery costs, etc.)

Appendix C. Annual Deployment Plan

Year	L2 Ports	DCFC Ports	Cost Estimate
2020 (Existing infrastructure)	94	11	N/A
2021	18	4	\$852,400
2022	48	7	\$1,603,900
2023	60	7	\$1,685,500
2024	90	9	\$2,254,500
2025	120	13	\$3,156,000
2026	152	17	\$4,093,600
2027	146	13	\$3,332,800
2028	116	13	\$3,128,800
2029	116	7	\$2,048,800
2030	120	0	\$816,000
Total	1,080	101	~ \$23,000,000

Appendix D. Vehicle Models Options

Vehicle Type	Example EV models
CAR	
BEV	<ul style="list-style-type: none"> • Chevy Bolt (Available) • Nissan Leaf (Available) • VW e-Golf (Available) • Hyundai Ioniq (Available) • Kia Niro (Available) • Kia Soul (Available)
PHEV	<ul style="list-style-type: none"> • Kia Niro (Available) • Prius Prime (Available) • Kia Optima (Available)
PICK UP TRUCK	
BEV	<ul style="list-style-type: none"> • Rivian R1T (2021, Announced) • Chevy pick-up (2022, Announced) • F-150 (2022, Announced)
SUV	
BEV	<ul style="list-style-type: none"> • Volvo XC40 (2021, Announced) • VW ID4 (2021, Announced)
PHEV	<ul style="list-style-type: none"> • Ford Escape (2021, Announced) • Mitsubishi Outlander (Available)
VAN	
BEV	<ul style="list-style-type: none"> • Chanje V1800 (Available) • Ford Transit (2022, Announced)
PHEV	<ul style="list-style-type: none"> • Toyota RAV4 prime (2021, Announced)



This report was prepared by Dunsky Energy Consulting. It represents our professional judgment based on data and information available at the time the work was conducted. Dunsky makes no warranties or representations, expressed or implied, in relation to the data, information, findings and recommendations from this report or related work products.