AUGUST 2021

ELECTRIC VEHICLE CHARGING IN MULTI-UNIT RESIDENTIAL BUILDINGS

A STRATEGY FOR THE CITY OF NORTH VANCOUVER

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DISCLAIMER

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ACKNOWLEDGEMENTS

The author would like to thank Larisa Lensink, Paul Forsyth, Jennifer Draper, Blair Underhill, Ian Neville, Jennifer Neville, and Mahdis Araujo for their contributions, feedback, and guidance throughout this project.

Photo by Mike Bird on Pexels

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LIST OF ABBREVIATIONS

- **A –** Amperage
- **BEV –** Battery Electric vehicle
- **DCFC –** Direct Current Fast Charging
- **EV –** Electric Vehicle
- **EVEMS –** Electric Vehicle Energy Management Systems
- **MSRP –** Manufacturer Suggested Retail Price
- **PHEV –** Plugin Hybrid Electric Vehicle
- **kW -** Kilowatt
- **kWh –** Kilowatt-hour
- **PPP –** Public-Private Partnership
- **RTC –** Right to Charge
- **V –** Volt
- **VKT –** Vehicle Kilometers Travelled

GLOSSARY OF TERMS

Battery Electric Vehicles (BEVs) – Vehicles that are fully recharged using energy from the electric grid[1]. These vehicles produce no tailpipe emissions and significantly fewer charging emissions, which range depending on the type of energy used to power electricity.

Plug-In Hybrid Electric Vehicles (PHEVs) – Vehicles that contain a gas-powered engine and an electric-powered battery that recharges by plugging into the grid.[2] PHEVs have a longer range than BEVs because of their internal combustion engine.

Level 1 Charging – The most basic and inexpensive method of recharging EVs. Level 1 charging requires a portable cord charger and power from a 120V 15A household outlet. It takes a little over 20 hours to recharge a depleted 40 kWh EV battery, which is effective for residents who do not drive regularly or only drive small distances from their homes and need a top-up.[3] In Metro Vancouver, the cost of installing level 1 charging generally ranges between $300 and $2,500.[4]

Level 2 Charging – The most common way to publicly recharge EVs. This infrastructure can be provided on city-owned property, in front of private businesses, or installed in residential homes. Level 2 charging requires power from a 240V 30A outlet and provides around 7.2kW of power to

[1] EVgo. (n.d.). Types of Electric Vehicles. Retrieved from https://www.evgo.com/ev-drivers/types-of-evs/#60
[2] EVgo. (n.d.). Types of Electric Vehicles. Retrieved from https://www.evgo.com/ev-drivers/types-of-evs/#60
https://www.rvo.nl/sites/default/files/2020/06/Quickscan-EV-Market-British-Columbia-and-Vancouver.pdf
[3] Pollution Probe & Delphi Group. (2019). Guide to Electric Vehicle Charging in Multi-Unit Residential Buildings. Retrieved from https://www.pollutionprobe.org/press-release-guide-to-ev-charging-in-murbs/. pp.14
[4] Metro Vancouver. (n.d.) Installing a charger in an apartment or townhouse. Retrieved from http://www.metrovancouver.org/services/air-quality/climate-action/transportation-programs/ev-strata-condo/key-info/chargers-installation-costs/Pages/default.aspx

EVs, which can charge a fully depleted 40kWh battery in about 5 hours.[5] The cost of installing level 2 charging infrastructure typically ranges between $6,000 and $20,000.[6]

Level 3 (DCFC) Charging – The fastest method of recharging an EV battery. This type of charger is essential to support the BC and Canada-wide EV charging network and is typically placed close to highways for easier access. Level 3 charging uses power from a 480V 125A direct current plug and can charge a 40kwh battery in less than an hour.[7] Level 3 charging costs between $50,000 and $100,000 to install due to the demanding infrastructure requirements.[8]

Electric Vehicle Energy Management Systems (EVEMS) – Control the total load capacity of EV chargers to ensure maximum charging speeds for multiple vehicles without exceeding the capacity of the electrical network.[9] For example, if 1 car is charging on an Electric Vehicle Energy Management System (EVEMS), it will receive 100% of the power from the circuit. If two cars are charging on an EVEMS, each will receive 50% power from the circuit. EVEMS can also be manually set to provide less power during peak hours and full power during non-peak hours of energy use in a building.[10]

Multi-Unit Residential Building - Structures with a common building entrance and separate internal units that are constructed for residential dwelling purposes.[11] These buildings are commonly low, mid, or high-rise apartments that have either a locked underground parking lot or an unlocked above-ground parking lot for residential use.

Range Anxiety – The fear that EV drivers will run out of electricity halfway through their trip and get stranded.[12] This fear can be reduced by increasing the range of EV batteries and providing more public charging stations.

[5] Pollution Probe & Delphi Group. (2019). https://www.pollutionprobe.org/press-release-guide-to-ev-charging-in-murbs/. pp.14
[6] Metro Vancouver. (n.d.) Installing a charger in an apartment or townhouse. Retrieved from http://www.metrovancouver.org/services/air-quality/climate-action/transportation-programs/ev-strata-condo/key-info/chargers-installation-costs/Pages/default.aspx
[7] Pollution Probe & Delphi Group. (2019). Guide to Electric Vehicle Charging in Multi-Unit Residential Buildings. Retrieved from https://www.pollutionprobe.org/press-release-guide-to-ev-charging-in-murbs/. pp.16
[8] Plug In BC. (n.d.). The BC Electric Vehicle Infrastructure Project: DC Fast Charging. Retrieved from https://pluginbc.ca/wp/wp-content/uploads/2014/08/FAQ-EV-DCFC-pilot-2Oct2014.pdf
[9] Relight Solutions. (n.d.) EV Energy Management Systems (EVEMS) – What they are and when to consider one. Retrieved from https://www.relightsolutions.com/evems/
[10] Plug In BC. (2021). Installing Electric Vehicle Charging in Your Building. Retrieved from https://pluginbc.ca/wp/wp-content/uploads/2021/01/Installing_Electric_Vehicle_Charging_MURB.pdf
[11]Boma Canada. (n.d.) Building Definitions. Retrieved from http://bomacanada.ca/bomabest/resourcesupdates/buildingdefinitions/#:~:text=Multi%2DUnit%20Residential%20Building%20(MURB,connected%20by%20an%20interior%20door.
[12] Plug n' Drive. (n.d.). Electric Vehicle Range. Retrieved from https://www.plugndrive.ca/electric-vehicle-range/

EXECUTIVE SUMMARY

Accelerating the rate of Electric Vehicle (EV) adoption in the City of North Vancouver is a key strategy in achieving the City's climate target of net zero emissions by 2050.

Private vehicles currently contribute around 45% of total greenhouse gas emissions in the City of North Vancouver.[13] This amount of pollution is unsustainable and goes against the City's long-term sustainability plans, including section 2.3.8 of the 2014 OCP which aims to introduce transportation options that reduce fossil fuel use, such as walking, cycling, transit, carpooling, and low-emission vehicles.[14]

The City of North Vancouver introduced an electric vehicle strategy in 2018 to remove barriers to EV ownership by increasing access to charging infrastructure and providing public education about EVs and EV charging. While the targets for City-provided charging infrastructure have been met, significant barriers to EV charging still exist for many residents, especially those living in multi-unit residential buildings (MURBs) that prevent them from owning an EV. This report identifies and analyzes current best practices for supporting EV drivers who lack at-home charging opportunities, including an analysis of public charging infrastructure opportunities, public-private partnerships, policy advocacy, education, and MURB retrofits. Given that 88% of residents in the City of North Vancouver live in MURBs that face significant barriers to accessing at-home charging, it is necessary for the City to support convenient access to public and private charging opportunities.[15] Addressing the barriers to accessing EV charging is necessary to accelerate EV uptake and to meet emission reduction goals.

One of the most effective methods of increasing access to charging is supporting full-building EV retrofits through rebate top-ups, education campaigns, and administrative support. Residents with access to at-home EV charging are significantly more likely to purchase an EV due to the convenience and lower charging costs compared to public charging stations. Implementing these programs will support the City of North Vancouver's goal of accelerating EV uptake. The financial barrier to installing EV infrastructure is a significant deterrent for most strata corporations, residents, and building owners. Adding EV-Ready (100%) or large-scale retrofits is the only way to efficiently future-proof MURBs in the City and ensure that the building's electrical capacity is not overloaded by incremental EV charging retrofits. Following retrofit support, expanding the public charging network can affectively compensate EV charging for buildings that are unable to add charging infrastructure. This may take the form of City-owned infrastructure or developing public-private partnerships.

[13] City of North Vancouver Commission Inventory. (2019). Source not published online. Information received from Larisa Lensink, Planner 1, City of North Vancouver.
{14] City of North Vancouver. (2014). Official Community Plan. Retrieved from https://www.cnv.org/your-government/official-community-plan. pp. 47
[15] City of North Vancouver. (n.d.) 2018-2022 Council Strategic Plan. Retrieved from https://www.cnv.org/your-government/mayor-and-council/council-strategic-plan

Section 1 of the report includes background information about the project, such as the City of North Vancouver's Climate goals, the 2018 EV strategy outcomes, and why accelerating EV adoption is a priority in the City. *Section 2* provides an overview of the current EV landscape in the City such as transportation statistics, City demographics, and barriers to at-home EV charging faced by City residents. *Section 3* of the report outlines and analyzes best practices for overcoming barriers to EV charging. Each best practice includes considerations for the City of North Vancouver and steps the City would need to take to implement the policy or program. Finally, *Section 4* analyzes the barriers and best practices identified in *Sections 2 and 3* and outlines high and medium priority actions to improve access to EV charging and to accelerate EV adoption. This includes recommended locations for public EV charging stations, opportunities for public-private partnerships, and the feasibility of implementing policy changes or support programs in the future.

The City of North Vancouver must take steps to improve the public EV charging network and to support at-home charging for people living in MURBs to meet climate and EV ownership goals. This report analyzes a number of different support methods including financial, educational, administrative, and policy advocacy that can be spearheaded or reinforced by the City. A mix of the best practices identified in Section 3 of the report will be required to adequately support the growing ownership of EVs and accelerate EV uptake. The recommended actions for the City of North Vancouver have been summarized in *Table 1*. The highest priority actions are highlighted in green and medium-priority actions are highlighted in yellow. Implementing some or all of the best practices identified below will help accelerate the rate of EV adoption in the City of North Vancouver and support the City in achieving its goal of producing net-zero emissions by 2050.

CATEGORY	ACTIONS FOR THE CITY OF NORTH VANCOUVER
MURB Retrofits	Explore opportunities to finance EV charging rebate top-ups. Give priority to buildings that are planning EV-Ready or large-scale retrofits. Assess EV uptake in rented MURBs and look into providing rebate top-ups specifically for rental units if needed.
MURB Retrofits	Explore opportunities to provide low or no-interest loans for the purchase and installation of EV charging infrastructure. Collaborating with Vancity is one option for providing this type of financial support.
Education	Support EV-Ready retrofits in MURBs or standalone EV chargers in shared parking spaces by developing an education and awareness campaign. This campaign can be shared through multiple channels such as social media, newspapers, local billboards, and the City's website. Use guidance materials developed by BC Hydro, Plug-In BC, and Emotive.
Education	Explore funding opportunities for new education programs, such as Emotive's COIP.

Education	Develop an education campaign to support strata councils and residents when Right to Charge legislation is implemented in BC. This campaign can outline the benefits of EV-Ready retrofits over standalone retrofits.
Policy	Through the development application process, encourage large developments to provide publicly accessible EV charging stations. This would be in addition to the 100% EV-Ready parking spaces in residential buildings and 45% EV ready parking spaces in non-residential buildings already mandated by the City.
Public Charging	Analyze the recommended public charging station locations in this report and begin reaching out to private property owners to gauge their interest in a PPP. Once locations are identified, install public charging stations to ensure all MURBs are within a 5-minute walk of EV charging. Prioritize high-density areas and locations that are central to multiple MURBs. This can be accomplished through a mix of City-owned on-street and off-street charging options or through the development of PPPs.
Public Charging	Investigate the opportunity to install EV chargers on streetlight poles. Identify areas in the City with appropriate infrastructure and then communicate and collaborate with BC Hydro to develop a pilot project. Follow the City of Vancouver's streetlight pole pilot project once it is developed.
Public Charging	Develop an education and awareness campaign directed towards local businesses. Outline the benefits of providing publicly accessible EV charging and types of shared revenue business models. Provide contact information or an application link for businesses to explore a PPP opportunity with the City. Reach out to gas companies with stations in the City and inquire about their EV charging plans. Advocate to have EV charging stations installed in the City of North Vancouver.
Public Charging	Collaborate with the District of North Vancouver to identify areas for public EV charging stations along the border of the City of North Vancouver that would benefit both jurisdictions. Areas of the City of North Vancouver such as Region F in the analysis are disconnected from EV charging stations due to the Upper Levels Highway and have limited areas for EV charging stations due to the proximity to the City's border. Since an EV charging station would benefit residents from both the City and the District of North Vancouver, collaborating on a location could be beneficial.
Public Charging	Develop a program to improve public EV charging signage or provide an opportunity to combine public art with EV charging stations.

Table 1 - Recommended actions to increase EV charging in the City of North Vancouver

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INTRODUCTION

Accelerating the rate of Electric Vehicle (EV) adoption in the City of North Vancouver is a key strategy in achieving the City's climate target of net zero emissions by 2050. Currently, private vehicles contribute around 45% of total greenhouse gas emissions in the City.[16] This amount of pollution is unsustainable and goes against the City's long-term sustainability plans, including section 2.3.8 of the 2014 OCP which aims to introduce transportation options that reduce fossil fuel use, such as walking, cycling, transit, carpooling, and low-emission vehicles.[17]

EV uptake has been steadily increasing in BC due to support programs implemented by Federal, Provincial, and Municipal governments. In 2019, the BC government passed the Zero-Emission Vehicles Act which requires 100% of vehicles sold or leased by automakers to be EVs by 2040.[18] The transportation and fossil fuel sectors currently produce the highest amount of GHG emissions in BC. The purpose of the Zero-Emission Vehicles Act is to help reduce these emissions and support the province in reaching climate reduction goals. EVs are beneficial due to their lower level of emissions and long-term cost benefits compared to gas-powered vehicles. Research conducted by the Pembina Institute found that EVs produce 80% fewer lifecycle emissions than the average gasoline-powered vehicle.[19] Most of these lifecycle emissions are generated during the extraction of materials and vehicle manufacturing process, with significantly fewer emissions being produced from refueling and driving. EVs are recharged using electricity, which can be supplied by clean energy sources. EVs generate little-to-no tailpipe emissions, contain fewer mechanical parts, and cost less to recharge compared to gas-powered vehicles.[20]

The City of North Vancouver set out a vision in their 2014 Official Community Plan to become a vibrant, diverse, and highly livable community that is resilient to climate or other changes, and sustainable in its ability to prosper without sacrifice to future generations by 2031.[21] To support this vision, the City has designed and approved a number of actionable plans related to energy, resource conservation, and emissions reduction. Among the most significant of these plans was the City's 2018 Electric Vehicle (EV) Strategy. This document identified key actions across 5 categories to support the shift from high-emission internal combustion vehicles to low-emission electric vehicles. These categories include:

EV CHARGING INFRASTRUCTURE IN NEW BUILDINGS

RETROFITTING EXISTING BUILDINGS WITH EV CHARGING

ELECTRIFYING THE CITY'S FLEET

DEVELOPING MORE PUBLICLY ACCESSIBLE CHARGING INFRASTRUCTURE

DEVELOPING PUBLIC EDUCATION AND OUTREACH MATERIALS

[16] City of North Vancouver Commission Inventory. (2019). Source not published – Information received from Larisa Lensink.
[17] City of North Vancouver. (2014). Official Community Plan. Retrieved from https://www.cnv.org/your-government/official-community-plan. pp. 47
[18] Government of British Columbia. (2019). Zero-Emission Vehicles Act. Retrieved from https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/transportation-energies/clean-transportation-policies-programs/zero-emission-vehicles-act
[19] City of North Vancouver. (2018). Electric Vehicle Strategy. Retrieved from https://www.cnv.org/-/media/city-of-north-vancouver/documents/electric-vehicles/electric-vehicle-strategy-september-2018.ashx pp.2
[20] Pollution Probe. (2019). Zero Emission Vehicle Charging in Multi-Unit Residential Buildings and or Garage Orphans. Retrieved from https://www.pollutionprobe.org/wp-content/uploads/ZEV-Charging-in-MURBs-and-for-Garage-Orphans-1.pdf pp. 10
[21] City of North Vancouver. (2014). Official Community Plan. Retrieved from. https://www.cnv.org/your-government/official-community-plan. Pp.2
[22] City of North Vancouver. (2018). Electric Vehicle Strategy. Retrieved from https://www.cnv.org/-/media/city-of-north-vancouver/documents/electric-vehicles/electric-vehicle-strategy-september-2018.ashx pp.5-13

Since being adopted in 2018, the City has completed many of the actions set out in the 2018 EV strategy; however, significant barriers continue to limit at-home charging opportunities for people living in multi-unit residential buildings (MURBs). In order to promote widespread adoption of electric vehicles and meet the City's climate goals, a strong combination of at-home charging and public charging stations will be necessary to support residents who cannot charge their vehicle at home.

The purpose of this report is to identify opportunities to improve EV charging access for residents with barriers to home charging in the City of North Vancouver. This report will assess residential and public charging opportunities in the City and will determine priority areas for public EV charging infrastructure along with potential models and recommendations for providing this infrastructure.

OBJECTIVES & METHODOLOGY

This report has 4 key objectives:

Research: Identify barriers, opportunities, and best practices for improving EV charging access for people living in MURBs and garage orphans.

Locate: Develop GIS maps to visually identify areas in the City of North Vancouver with barriers to home charging, with a particular focus on MURBs and garage orphans.

Identify: Analyze regions in the City with high EV charging needs and develop a map with recommended locations for public charging stations in those areas.

Recommend: Provide a summary of the most effective actions the City can take to improve access to EV charging infrastructure.

These objectives are completed using GIS mapping, in-depth interviews with EV experts and stakeholders, and literature reviews. Data for the GIS mapping was provided by the City's GIS team or developed using Google Maps, Google Street View, and Plug Share's public EV charging maps. This data is used to visually represent EV charging stations, neighbourhoods that lack access to EV charging infrastructure, and recommended locations for new public charging stations. The outcome of these analyses will be used to identify locations in the City that lack EV charging and potential solutions to meet charging needs including their advantages and disadvantages. The results of this study will inform the City of North Vancouver's approach to neighbourhood EV charging. This report is categorized into four sections, as follows:

Section 1: Why the transition to EVs is a priority in the City of North Vancouver – This section includes background information about the project, including 1) an outline of how supporting EV uptake will help the City meet its climate goals, 2) an overview of the City's 2018 EV strategy and the progress to date in meeting the actions outlined in the plan, and 3) an overview of the City's current EV infrastructure.

Section 2: At-home charging potential and barriers to charging in the City of North Vancouver – This section includes statistics and maps that outline building and land types, transportation methods, EV uptake and distribution, multi-family, rental, and strata buildings, and dwellings with no lane access in the City of North Vancouver.

Section 3: Best practices associated with EV charging in MURBS and improving city charging networks – This section analyzes best practices to overcome barriers to EV charging in MURBs. Each best practice includes considerations for the City of North Vancouver and steps the City would need to take to implement the policy or program.

Section 4: Recommendations for Priority Neighbourhoods in the City of North Vancouver – The final section of the report analyzes the barriers and best practices identified in Sections 2 and 3 to provide a list of high and medium priorities for the City. This includes recommended locations for public EV charging stations, opportunities for public-private partnerships, and recommended policy changes or support programs to accelerate EV adoption in the City.

SECTION 1: WHY THE TRANSITION TO EVS IS A PRIORITY FOR THE CITY OF NORTH VANCOUVER

BACKGROUND

In order to meet emission reduction goals, the City of North Vancouver must prioritize and support a widespread transition from gas-powered vehicles to EVs. There are a number of federal and provincial initiatives aimed at increasing EV uptake, including BC's Zero-Emission Vehicles Act which requires 100% of vehicle sales to be EVs by 2040.[23] Other programs include rebates for the purchase and installation of EVs and EV charging infrastructure, non-financial incentives to own an EV, and education campaigns designed to reduce misconceptions about EV ownership. While these initiatives have supported EV uptake in British Columbia (BC), the City of North Vancouver has identified the need to provide additional support methods and incentives to accelerate the rate of EV uptake in the City.

[23] Ministry of Energy, Mines and Petroleum. (2020). Province puts in place rules for 100% electric-vehicle sales by 2040. Retrieved from https://archive.news.gov.bc.ca/releases/news_releases_2017-2021/2020EMPR0031-001416.html

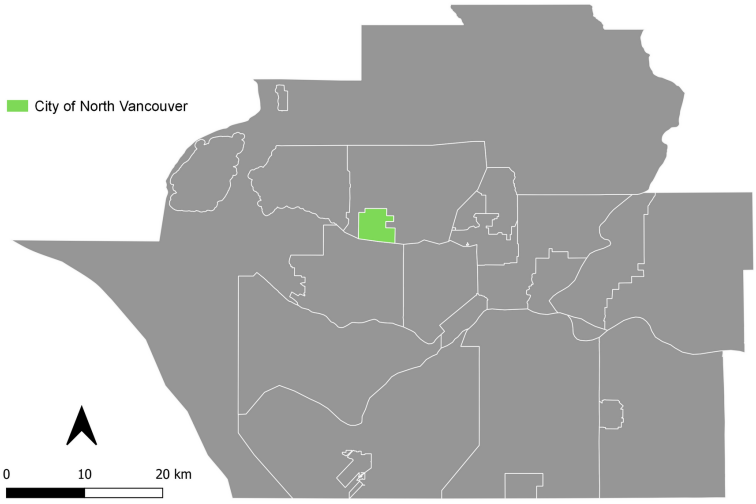

Figure 1 - Regional Context of North Vancouver (City)

The City of North Vancouver is one of the most densely populated municipalities in Metro Vancouver and has a variety of land uses in close proximity to each other (*See Figure 1*).[24] This closely spaced network of commercial and residential buildings is well-suited for EVs, which can have a lower driving range compared to gas-powered vehicles. According to the City's 2014 Official Community Plan, 83% of daily trips made by residents in 2014 remained on the North Shore,[25] with an average of 30.14 vehicle kilometers traveled (VKT) per day in 2019.[26] This average distance of daily travel makes level 1 or level 2 at-home charging an efficient method of recharging EVs for most residents in the City of North Vancouver. Cars parked in a garage or parking lot with access to EV infrastructure can recharge overnight through level 1 charging or be topped up in a few hours through level 2 charging. Alternatively, vehicle batteries can be topped up in 15-30 minutes by public Direct Current Fast Charging (DCFC) stations.

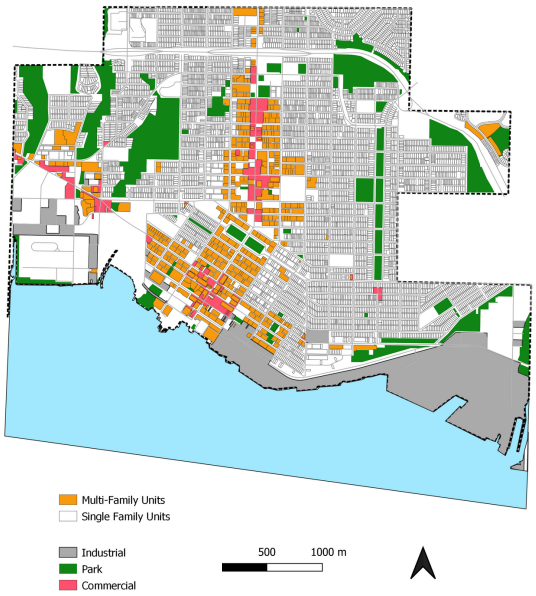

Figure 2 - Land use in the City of North Vancouver

[24] City of North Vancouver. (2014). Official Community Plan. Retrieved from https://www.cnv.org/your-government/mayor-and-council/-/media/6a7de69dc62d471f9630225e6f04db57.ashx. Pp.43

[25] City of North Vancouver. (2014). Official Community Plan. Retrieved from https://www.cnv.org/your-government/mayor-and-council/-/media/6a7de69dc62d471f9630225e6f04db57.ashx. Pp.42

[26] R.A. Malatest & Associates Ltd. & Associated Engineering (B.C.) Ltd. (2019). 2019 North Shore Transportation Survey. Retrieved from https://www.cnv.org/city-services/streets-and-transportation/transportation-planning-projects/north-shore-transportation-survey pp. 48

In 2019, 61% of City of North Vancouver residents over the age of 15 primarily commuted to work as a passenger or driver in a private vehicle.[27] This amounts to approximately 28,477 residents using single-occupancy vehicles on a daily basis, based on the City's population of 46,686 in 2019 (projected population aged 15+ from 2016 census data).[28] This number is even higher when leisure and errand driving is taken into account. In order to achieve net-zero emissions by 2050, transportation emissions will need to be significantly reduced by the promotion of active transportation, improved public transportation, and a mode shift to EVs. The current amount of public and private EV charging infrastructure in the City of North Vancouver is not sufficient to support accelerated EV ownership and does not promote EV uptake for residents living in MURBs.

MUNICIPAL EV POLICIES & PROGRESS TO DATE

The City of North Vancouver's 2018 Electric Vehicle Strategy

The City of North Vancouver developed the Electric Vehicle Strategy in 2018 to help accelerate the transition from gas-powered vehicles to EVs. This plan included a number of actionable items spread across 5 categories to improve EV uptake. These categories included:

1. Charging Infrastructure: New Construction
2. Charging Infrastructure: Existing Buildings
3. Public Charging Network
4. City Fleet and Equipment
5. Education and Outreach

Following the adoption of the Strategy, a number of policy changes, infrastructural developments, and education campaigns were implemented to improve access to EV charging infrastructure. Some of the most significant of these actions include the following:

EV STRATEGY CATEGORY	OUTCOME
Charging Infrastructure: New Construction	In 2019, the City adopted a Zoning Bylaw amendment which requires 100% of new residential parking stalls to be equipped with an energized outlet.[29] This policy ensures buildings are equipped to support EV charging and has led to the construction or plans for approximately 500 EV-Ready parking spots since its adoption in February 2019.[30] In 2021, the City adopted a Zoning Bylaw amendment to require 45% of new non-residential parking spaces to be EV-Ready, including parking spaces provided for commercial, institutional and industrial uses. This requirement will take effect in January 2022.

[27] R.A. Malatest & Associates Ltd. & Associated Engineering (B.C.) Ltd. (2019). 2019 North Shore Transportation Survey. Retrieved from https://www.cnv.org/city-services/streets-and-transportation/transportation-planning-projects/north-shore-transportation-survey. Pp. 3
[28] R.A. Malatest & Associates Ltd. & Associated Engineering (B.C.) Ltd. (2019). 2019 North Shore Transportation Survey. Retrieved from https://www.cnv.org/city-services/streets-and-transportation/transportation-planning-projects/north-shore-transportation-survey. Pp.19
[29] City of North Vancouver. (2020). AGENDA FOR THE REGULAR MEETING OF COUNCIL, HELD ELECTRONICALLY FROM CITY HALL, 141 WEST 14TH STREET, NORTH VANCOUVER, BC, ON MONDAY, DECEMBER 14, 2020 AT 5:30 PM. Retrieved from https://www.cnv.org/-/media/City-of-North-Vancouver/Documents/Council-Meeting-Agenda/2020/2020-12-14-Regular-Agenda-Package-for-December-14-2020.ashx pp.157
[30] City of North Vancouver. (2020). AGENDA FOR THE REGULAR MEETING OF COUNCIL, HELD ELECTRONICALLY FROM CITY HALL, 141 WEST 14TH STREET, NORTH VANCOUVER, BC, ON MONDAY, DECEMBER 14, 2020 AT 5:30 PM. Retrieved from https://www.cnv.org/-/media/City-of-North-Vancouver/Documents/Council-Meeting-Agenda/2020/2020-12-14-Regular-Agenda-Package-for-December-14-2020.ashx pp.157

Charging Infrastructure: Existing Buildings	The City has supported EV retrofits in existing multi-family buildings by promoting charging station rebates offered by the provincial government.
Public Charging Network	The City successfully met the infrastructure goals set out in the 2018 Electric Vehicle Strategy. In 2019, the City received financial support from NRCAN to install two additional DCFC stations and three level-2 charging stations for public use.[31] The City now has a total of 8 DCFC plugs, 8 Tesla Supercharger plugs, and 34 level 2 charging plugs.
Education and Outreach	In the summer of 2019, the City hosted a number of EV outreach events and a 'ride & drive' event with Metro Vancouver's Emotive EV Outreach Campaign and the Vancouver Electric Vehicle Association.[32] The purpose of these events was to provide opportunities for residents to experience EV driving and to learn answers to their questions about EVs and EV charging.

Table 2 – Outcomes of the City of North Vancouver's 2018 EV Strategy

The actions set out in the 2018 EV Strategy have supported EV uptake by future-proofing new buildings, addressing misinformation about EVs, and improving the public charging network. However, more work is necessary to enable widespread EV adoption. *Appendix A* provides more details about the City's 2018 EV Strategy and progress to date.

THE CITY'S PUBLIC CHARGING NETWORK & EV ADOPTION

The City of North Vancouver currently has 4 DCFC stations with a total of 4 charging ports, 1 Tesla Supercharger hub with 8 charging ports, and 22 level-2 chargers with a total of 34 charging ports (*Table 3*)

LOCATION	CHARGING LEVEL	NUMBER OF CHARGING STATIONS	NUMBER OF CHARGING PORTS	OWNERSHIP
Brooksbank	DCFC	1	1	CNV
1st Street	DCFC	2	2	BC Hydro
North Vancouver City Hall	DCFC	1	1	CNV
London Drugs	Tesla Supercharger	8	8	Private

[31] City of North Vancouver. (2020). AGENDA FOR THE REGULAR MEETING OF COUNCIL, HELD ELECTRONICALLY FROM CITY HALL, 141 WEST 14TH STREET, NORTH VANCOUVER, BC, ON MONDAY, DECEMBER 14, 2020 AT 5:30 PM. Retrieved from https://www.cnv.org/-/media/City-of-North-Vancouver/Documents/Council-Meeting-Agenda/2020/2020-12-14-Regular-Agenda-Package-for-December-14-2020.ashx pp.160

[32] City of North Vancouver. (2020). AGENDA FOR THE REGULAR MEETING OF COUNCIL, HELD ELECTRONICALLY FROM CITY HALL, 141 WEST 14TH STREET, NORTH VANCOUVER, BC, ON MONDAY, DECEMBER 14, 2020 AT 5:30 PM. Retrieved from https://www.cnv.org/-/media/City-of-North-Vancouver/Documents/Council-Meeting-Agenda/2020/2020-12-14-Regular-Agenda-Package-for-December-14-2020.ashx pp.162

MEC	Level 2	2	4	Private
Neptune	Level 2	2	4	Private
West Grand Boulevard	Level 2	1	2	CNV
Shipyards	Level 2	4	4	Private
ICBC Head Office	Level 2	2	4	Private
BCIT Marine Campus	Level 2	1	1	Private
CNV Operations Centre	Level 2	1	1	CNV
Capilano Mall	Level 2	2	2	Private
North Vancouver Public Library	Level 2	1	2	CNV
Lions Gate Hospital	Level 2	2	2	Private
LGH Evergreen House	Level 2	1	1	Private
London Drugs	Level 2	1	2	Private
Centennial Theatre	Level 2	1	2	CNV
Mahon Park	Level 2	1	2	CNV
TOTAL		**34**	**45**	

Table 3 – City of North Vancouver public EV charging stations

EVs make up approximately 2.6% of passenger vehicles registered in the City, with 741* registered EVs out of 28,551 vehicles registered in 2020. In order to accelerate EV uptake in the City, a greater number of public level 2 and level 3 charging stations will be needed. Public charging stations are necessary to provide convenient access to charging for residents who do not have access to at-home charging. The current distribution of public charging stations is outlined in *Figure 3*.

[*]the source data for the number of EVs registered in the City of North Vancouver is attributed to ICBC

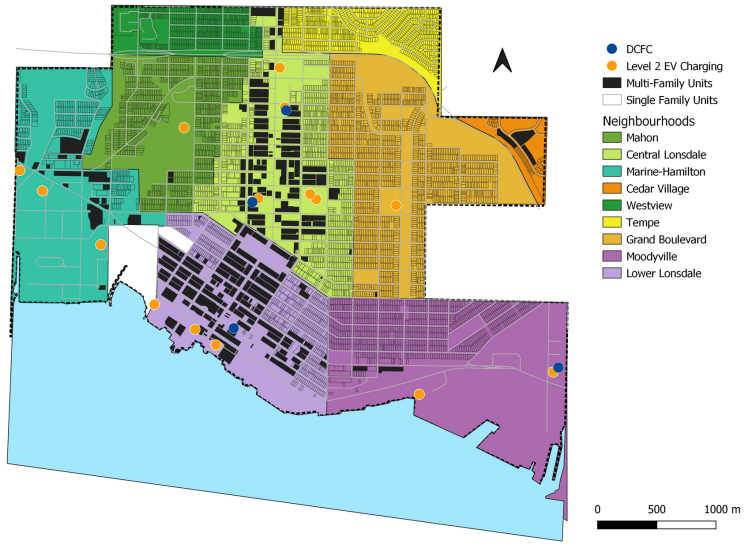

Figure 3 – EV charging stations and multi-family buildings per neighbourhood

SECTION 2: AT-HOME CHARGING POTENTIAL AND BARRIERS TO CHARGING IN THE CITY OF NORTH VANCOUVER

Residents living in single-family homes are more likely to have access to at-home EV charging infrastructure compared to residents living in MURBs. This is problematic for accelerating EV uptake in the City of North Vancouver because MURBs make up approximately 88% of dwellings in the City, with approximately 18,721 MURB dwelling units in total.[33] (*See Figure 4*) Furthermore, in 2016, approximately 47% of households rented their homes in the City of North Vancouver.[34] Residents renting single and multi-family homes or living in strata buildings face additional barriers to installing EV charging due to restrictions from landlords and the strata council that prevent the installation of EV charging infrastructure. Due to this landscape of building types, AES Engineering estimates that residents in the City of North Vancouver have a 20% lower chance of accessing at-home EV charging compared to the rest of Metro Vancouver.[35]

Figure 4 – Single-family and multi-family buildings in North Vancouver

MURBs, rental buildings, and strata buildings in the City are primarily centered around Lonsdale Avenue (*See Figure 5*).

[33] City of North Vancouver. (2018) 2018-2022 Council Strategic Plan. Retrieved from https://www.cnv.org/your-government/mayor-and-council/council-strategic-plan
[34] City of North Vancouver. (n.d.) Market Rental Housing. Retrieved from https://www.cnv.org/city-services/planning-and-policies/housing/market-rental-housing
[35] City of North Vancouver. (2020). AGENDA FOR THE REGULAR MEETING OF COUNCIL, HELD ELECTRONICALLY FROM CITY HALL, 141 WEST 14TH STREET, NORTH VANCOUVER, BC, ON MONDAY, DECEMBER 14, 2020 AT 5:30 PM. Retrieved from https://www.cnv.org/-/media/City-of-North-Vancouver/Documents/Council-Meeting-Agenda/2020/2020-12-14-Regular-Agenda-Package-for-December-14-2020.ashx pp.159

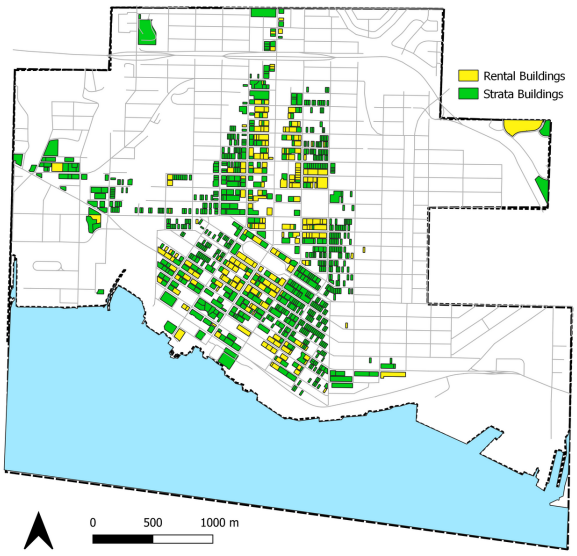

Figure 5 – Location of rental and Strata Buildings in the City of North Vancouver

Many of these buildings are within a 5-minute walk of an EV charging station, which can supplement the lack of at-home charging available for residents living there. However, the current number of public EV charging stations cannot adequately support the ongoing EV adoption rates. On top of the 5,496 units that are beyond a 5-minute walk from EV public EV charging stations, the current stations will become too congested for residents to conveniently access as EV uptake increases.

Based on the location of MURBs and existing public charging stations, 7 neighbourhoods were identified that lack access to public EV charging. MURBs were analyzed based on their approximate distance to public EV charging stations in meters. A 2-minute walk is approximately 160 meters and a 5-minute walk is approximately 400 meters. The red areas in *Figure 6* represent buildings that are further than a 5-minute walk from EV charging stations. These locations were used to develop the neighbourhood boundaries shown in *Figure 7*. These neighbourhoods are priority locations for future public EV charging infrastructure due to their distance from public EV charging stations. In addition to the other support methods identified in the report, these neighbourhoods represent areas of the City with the greatest need for more public charging. Potential locations for this infrastructure are identified in *Section 4* of the report.

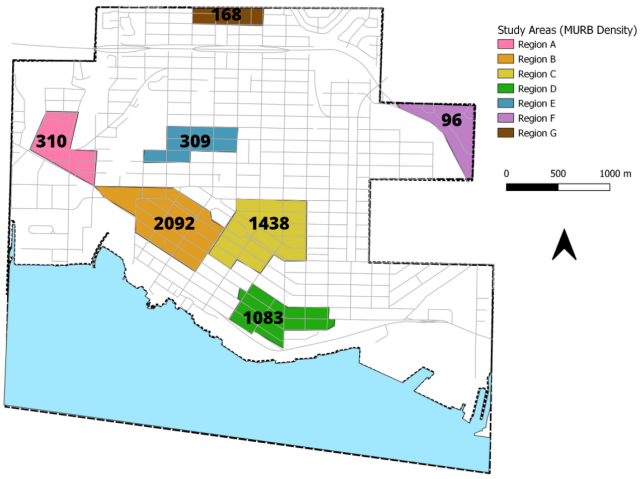

Figure 6 – Distance from MURBs to public EV charging stations

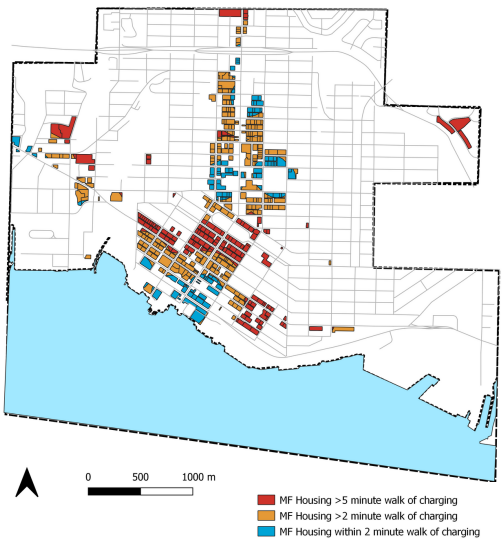

Figure 7 – MURB units per priority study area

CHALLENGES WITH EV CHARGING IN MULTI-UNIT RESIDENTIAL BUILDINGS

In 2015, the majority of EV drivers in Canada lived in single-family dwellings.[36] This is likely due to the convenience of charging at home and generally higher household incomes. In comparison, only 8% of EV users reported living in an apartment building in 2015.[37] Residents living in MURBs face infrastructural, financial, legal, and educational barriers to installing EV charging infrastructure in their building or parking stall. Specifically, some of these barriers include:

Physical Design and Space: The physical design of a building impacts the cost and feasibility of installing EV infrastructure. For example, placing the EV charging station closer to the electrical room decreases the cost of the installation, as less trenching and cable are needed.[38] Typically, this means that EV charging stations should be placed as close to the electrical room as possible in buildings that do not implement 100% building retrofits. The size and shape of parking stalls also impact the ability to install EV charging stations. Longer parking stalls with space on the floor or wall in front of them have more room to fit chargers.[39] If stalls are too small, there may not be adequate room to build level 2 stations without impeding driving space in the parking lot.

Electrical infrastructure: The electrical service in a MURB is generally shared between all private dwellings and common areas. The building's electrical capacity must be analyzed prior to EV charger installation to determine how many chargers can reasonably be installed with the current electrical load. The number of charging stations can be significantly limited by the building's transformers, electrical panels, power distribution, and feeders.[40] This problem is typically more severe in older buildings, which can have older electrical technology and infrastructure. An Electrical Contractor, EVEMS provider, or EV advisor can provide information on the current capacity, the best type of EV charging solution, and help develop an EV retrofit plan for the building.[41] In some cases, the building's electrical infrastructure may need to be upgraded to support EV charging. This is both an expensive and time-consuming process that is a significant barrier to EV charging.

Strata Processes and Provincial Acts: British Columbia is currently in the process of developing Right to Charge (RTC) legislation, which prevents condo corporations and strata councils from rejecting reasonable applications to install EV charging infrastructure. Currently, councils that do not want infrastructural changes made to the building can reject these applications and prevent all building users from installing EV chargers in their parking spaces. Strata corporations and landlords

[36] Pollution Probe & Delphi Group. (2019). Zero Emissions Vehicle Charging in Multi-Unit Residential Buildings and for Garage Orphans. Retrieved from https://www.pollutionprobe.org/wp-content/uploads/ZEV-Charging-in-MURBs-and-for-Garage-Orphans-1.pdf pp. 23
[37] Pollution Probe & Delphi Group. (2019). Zero Emissions Vehicle Charging in Multi-Unit Residential Buildings and for Garage Orphans. Retrieved from https://www.pollutionprobe.org/wp-content/uploads/ZEV-Charging-in-MURBs-and-for-Garage-Orphans-1.pdf pp. 23
[38] Boma Canada. (2021). Electric Vehicle Infrastructure Guide. Retrieved from http://bomacanada.ca/wp-content/uploads/2020/10/BOMA_EVI-Guideline.pdf pp. 12
[39]Pollution Probe & Delphi Group. (2020). Guide to Electric Vehicle Charging in Multi-Unit Residential Buildings. Retrieved from https://www.nrcan.gc.ca/sites/nrcan/files/energy/pdf/Revised_Guide_to_EV_Charging_in_MURBs_ENG_ACC.pdf pp.49
[40]Pollution Probe & Delphi Group. (2020). Guide to Electric Vehicle Charging in Multi-Unit Residential Buildings. Retrieved from https://www.nrcan.gc.ca/sites/nrcan/files/energy/pdf/Revised_Guide_to_EV_Charging_in_MURBs_ENG_ACC.pdf pp. 48
[41]Pollution Probe & Delphi Group. (2020). Guide to Electric Vehicle Charging in Multi-Unit Residential Buildings. Retrieved from https://www.nrcan.gc.ca/sites/nrcan/files/energy/pdf/Revised_Guide_to_EV_Charging_in_MURBs_ENG_ACC.pdf. pp. 50

currently have the power to reject these applications due to the BC Strata Property Act and individual strata corporation rules and bylaws. For example, changes to common property and changes to limited common property designation require approval from at least 75% of the strata council.[42] In some cases, these bylaws need to be amended to allow for EV charger installation.[43] This can be a long and complex process that adds administrative, legal, and time-based barriers to residents looking for at-home EV charging. Misconceptions and a lack of understanding about EV charging needs and growth are likely to reduce the number of approvals on a strata council.

Education and Awareness: Lack of education and misconceptions about the cost and process of installing EV charging is a significant barrier to EV uptake. One of the primary misconceptions is related to electricity costs for EV charging and the cost of installing charging infrastructure in a building. A survey conducted by BC Hydro in 2019 found that 25% of non-EV owners were hesitant to switch to EVs due to concerns about increased electricity costs at home.[44] While electricity costs do increase, EV owners save a significantly greater amount of money from no longer fueling their vehicles with gas. Additionally, 56% of non-EV owners believe that purchasing and installing an EV charger is more costly than it actually is.[45] Other misconceptions about EVs include concerns about range and the lack of public EV charging stations. Nearly 70% of respondents to the BC Hydro survey noted that the availability of public charging stations was one of the greatest factors preventing them from purchasing an EV.[46] While 60% of EV owners reported charging primarily at home, lack of at-home charging and limited public charging is a concern for people living in MURBs.

Cost of EV infrastructure: EV charging infrastructure can be cost-prohibitive due to installation costs, the type of technology used, and other infrastructural changes needed (*See Table 4*). While government rebates can reduce these costs, many residents are unable to afford new vehicles along with costly retrofits in their buildings. As a result, cost is often identified as a bigger barrier to EV uptake than range anxiety.[47] For residents living in MURBs, the cost of EV charging retrofits may be higher due to the distance of their parking stall to the power supply panel. Additionally, upgrading the building's electrical service due to limited capacity is an expensive and time-consuming process. EV charging retrofits can be less expensive per stall if done to all parking stalls at the same time. Additional government supports and education about installation costs are necessary to address cost-related barriers.

[42] Government of British Columbia. (n.d.) Types of Strata Voting. Retrieved from https://www2.gov.bc.ca/gov/content/housing-tenancy/strata-housing/operating-a-strata/meetings-and-voting/types-of-voting
[43] Metro Vancouver. (n.d.) Acts, Bylaws, and Rules. Retrieved from http://www.metrovancouver.org/services/air-quality/climate-action/transportation-programs/ev-strata-condo/key-info/home-owner-approval/Pages/default.aspx
[44]BC Hydro. (2019). Old Habits Drive Hard: How British Columbians' fueling habits are driving misconceptions about EV Charging. Retrieved from https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/news-and-features/bc-hydro-ev-home-charging-report.pdf pp.2
[45] BC Hydro. (2019). Old Habits Drive Hard: How British Columbians' fueling habits are driving misconceptions about EV Charging. Retrieved from https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/news-and-features/bc-hydro-ev-home-charging-report.pdf pp. 2
[46] BC Hydro. (2019). Old Habits Drive Hard: How British Columbians' fueling habits are driving misconceptions about EV Charging. Retrieved from https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/news-and-features/bc-hydro-ev-home-charging-report.pdf. pp. 3
[47]Krishna, G. (2021). Understanding and Identifying Barriers to Electric Vehicle Adoption through Thematic Analysis. Retrieved from https://reader.elsevier.com/reader/sd/pii/S2590198221000713?token=70A9F977F76EDD891450C6A4E3647302409680764CFC6E420B51F99D15F1EFAB7876B5AEB7373C3A8E385BE0977C6262&originRegion=us-east-1&originCreation=20210707164341 pp.4

CHARGING LEVEL	ESTIMATED COST FOR INSTALLATION	
Level 1	**$300 - $2,500**	[48]
Level 2	**$6,000 - $20,000**	[49]
DCFC	**$50,000 - $100,000**	[50]

Table 4 – Estimated costs for installing EV charging infrastructure

CHALLENGES WITH EV CHARGING FOR GARAGE ORPHANS

Garage orphans are residents who do not have access to off-street parking at their homes.[51] This term is typically used to describe single-family dwellings, but can also apply to MURBs that do not have dedicated private off-street parking spaces. One of the primary barriers to installing EV charging for garage orphans in the City of North Vancouver is curbside parking bylaws and a lack of on-street parking opportunities. While garage orphans typically park in front of their homes, residential curbside parking is not privatized in the City.[52] As a result, homeowners do not have the right to reserve parking space in front of their homes, which can limit the ability to install EV charging infrastructure. Garage orphans are not very common in the City of North Vancouver and nearly all of the single-family homes without lane access have a dedicated garage or driveway that could host EV charging infrastructure (*See Figure 8*). Other garage orphans in the city have access to on-street parking in front of or close to their homes. As such, addressing EV charging opportunities for garage orphans is not analyzed in this report. Please see *Appendix B* for an overview of level 1 charging through extension cords as a method of supporting garage orphans.

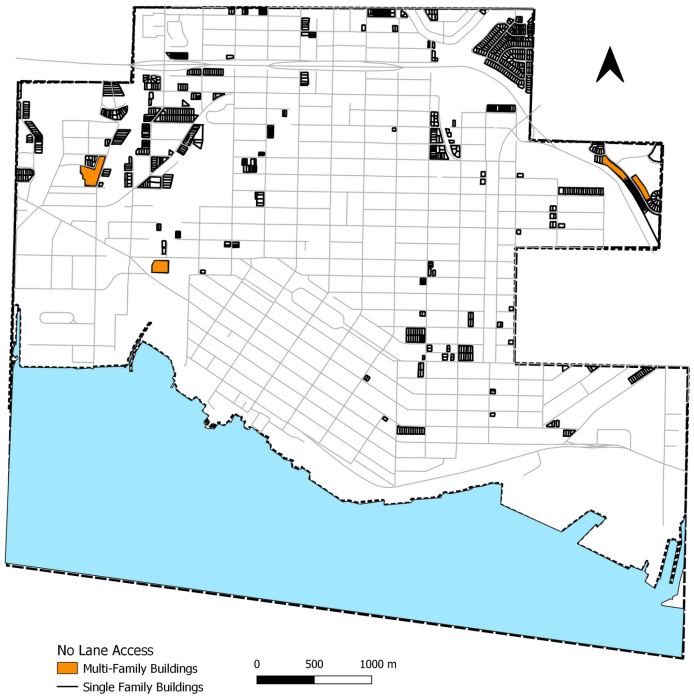

Figure 8 – Dwellings with no lane access in the City of North Vancouver

[48] Metro Vancouver. (n.d.) Installing a charger in an apartment or townhouse. Retrieved from http://www.metrovancouver.org/services/air-quality/climate-action/transportation-programs/ev-strata-condo/key-info/chargers-installation-costs/Pages/default.aspx
[49] Metro Vancouver. (n.d.) Installing a charger in an apartment or townhouse. Retrieved from http://www.metrovancouver.org/services/air-quality/climate-action/transportation-programs/ev-strata-condo/key-info/chargers-installation-costs/Pages/default.aspx
[50] Plug In BC. (n.d.). The BC Electric Vehicle Infrastructure Project: DC Fast Charging. Retrieved from https://pluginbc.ca/wp/wp-content/uploads/2014/08/FAQ-EV-DCFC-pilot-2Oct2014.pdf
[51] City of Vancouver. (2016). Vancouver's EV Ecosystem Strategy. Retrieved from https://vancouver.ca/files/cov/EV-Ecosystem-Strategy.pdf . Pp.28
[52] City of North Vancouver. (n.d.). Parking FAQs. Retrieved from https://www.cnv.org/city-services/streets-and-transportation/parking-in-the-city/parking-faqs#:~:text=There%20is%20no%20such%20thing,residential%20street%20unless%20posted%20otherwise.

THE NEED FOR CONVENIENT ACCESS TO EV CHARGING

The most convenient method of recharging an EV is through at-home charging stations. Having easy access to a private charger ensures that drivers do not have to wait to charge, allows for overnight charging, reduces the likelihood of the charger being under maintenance, and allows drivers to charge until their battery is full. Reliably being able to charge at any time is important for the confidence of an electric vehicle buyer and is necessary to accelerate EV uptake.[53] Public fast-charging stations can provide an option for residents who do not have access to at-home charging and can supplement other public charging options.[54] However, at-home charging is the most common and preferred method of recharging in North America.[55]

Most residents living in MURBs in the City of North Vancouver face significant barriers to installing EV charging infrastructure. If these barriers are not mitigated by the City, these residents are less likely to transition from their gas-powered vehicle to an EV. A study conducted by the US Department of Energy found that 3.1 public DCFC plugs and 40 public level-2 charging plugs per 1,000 EVs are necessary to support the growing EV market and reduce range anxiety.[56] This number is meant to support EV owners who do not have access to home charging and assumes that around 88% of charging is done at home.[57] Given that the City of North Vancouver will likely have a lower percentage of at-home charging, more public charging stations will be necessary to accelerate EV adoption.

The current landscape of public EV charging stations is sufficient to meet the demand for charging based on the number of public charging stations compared to current EV ownership. However, these stations will quickly become congested as adoption rates increase and will not be sufficient to support EV charging as more residents living in MURBs transition to EVs.

SECTION 3: CURRENT BEST PRACTICES FOR ADDING EV CHARGING IN MURBS AND IMPROVING CITY CHARGING NETWORKS

TYPES OF MURB RETROFITS

EV retrofits are upgrades to existing buildings that provide the electrical infrastructure to support EV charging. EV retrofits are typically more expensive than charging infrastructure installed at the time of construction due to the cost of upgrading a building's electrical service and laying new wiring and cables. In the City of North Vancouver, new MURBs are required to be 100% EV ready and capable

[53] The International Council on Clean Transportation. (2018). Lessons Learned on Early Electric Vehicle Fast-Charging Deployment. Retrieved from https://theicct.org/sites/default/files/publications/ZEV_fast_charging_white_paper_final.pdf pp. 29
[54] The International Council on Clean Transportation. (2018). Lessons Learned on Early Electric Vehicle Fast-Charging Deployment. Retrieved from https://theicct.org/sites/default/files/publications/ZEV_fast_charging_white_paper_final.pdf pp. 29
[55] ChargeHub. (n.d.). A Beginner's Guide to Electric Cars: How to charge and EV at home. Retrieved from https://chargehub.com/en/home-charging-guide-electric-vehicles.html
[56] US Department of Energy. (2017). National Plug-In Electric Vehicle Infrastructure Analysis. Pp. xi. Retrieved from https://www.energy.gov/sites/default/files/2017/09/f36/NationalPlugInElectricVehicleInfrastructureAnalysis_Sept2017.pdf
[57] US Department of Energy. (2017). National Plug-In Electric Vehicle Infrastructure Analysis. Pp. 6. Retrieved from https://www.energy.gov/sites/default/files/2017/09/f36/NationalPlugInElectricVehicleInfrastructureAnalysis_Sept2017.pdf

of providing level 2 charging.[58] However, the City of North Vancouver does not have the regulatory authority to require retrofits in existing buildings. This is problematic because many of the existing MURBs in the City will remain for decades, which will prevent residents living in those accommodations from accessing at-home EV charging. Adding EV retrofits to existing buildings will be necessary to accelerate EV uptake and meet the climate reduction goals in the City of North Vancouver. There are two methods of installing EV retrofits that have unique benefits and detriments:

1. **Installing retrofits in all parking spaces at the same time (EV-Ready building retrofits).**
2. **Installing retrofits a few at a time (Standalone EV charging station retrofits).**

EV-Ready (100%) Building Retrofits

EV charging retrofits are the most cost and energy-efficient if they are added to all of the parking stalls in a building at the same time. 'EV-Ready' means that parking stalls are equipped with an electrical socket that can support level 2 EV charging and may not necessarily have a physical charging station. While the upfront cost of EV-Ready retrofits is high, the cost per parking stall is significantly smaller compared to the cost of standalone retrofits. AES Engineering estimates that EV-Ready retrofits cost an average of $1,000 per stall and standalone retrofits cost an average of $7,000 when rebates are applied.[59] Furthermore, EV-Ready retrofits have more funding opportunities than incremental retrofits, such as Clean BC's 'EV Ready' MURB retrofits (*See Table 5*). EV-ready retrofits are also a more efficient choice in terms of energy usage and supporting EV uptake. With the use of EVEMS, multiple EVs can charge at the same time without exceeding the electrical capacity of the building.[60] These systems can automatically or manually control the load capacity of plugged-in EV chargers to ensure each vehicle receives the maximum charging speed possible.[61] During peak hours of energy use in a building, charging speeds will be slower. During non-peak hours, EVs may receive full or close to full-power charging. Furthermore, EV-Ready retrofits only require a one-time construction project that will support all current and future residents.[62] As a result, there will be less paperwork, strata council meetings, bylaw changes, and construction compared to standalone EV retrofits. If 100% retrofits are not possible in a building, adding groups of EV charging infrastructure at the same time may also be an effective method of providing EV charging. It is unlikely that all residents in a building will own an EV within the next 50 years, so group retrofits may suffice until existing buildings are rebuilt. Regardless of the size of the retrofit, installing multiple chargers at the same time is less expensive per stall and more energy-efficient compared to incremental retrofits.

[58] Plug In BC. (n.d.). Electric Vehicle Policies. Retrieved from https://pluginbc.ca/policy/
[59] Brendan McEwan. (2020). Retrofitting EV Chargers into a Multifamily Building: The Merits of a 100-per-cent EV-Ready Approach. Retrieved from https://electricautonomy.ca/2021/02/11/multifamily-building-ev-retrofit/
[60] Brendan McEwan. (2020). Retrofitting EV Chargers into a Multifamily Building: The Merits of a 100-per-cent EV-Ready Approach. Retrieved from https://electricautonomy.ca/2021/02/11/multifamily-building-ev-retrofit/
[61] Relight Solutions. (n.d.). EV Energy Management Systems (EVEMS) – What are they and when to consider one. Retrieved from https://www.relightsolutions.com/evems/
[62] Brendan McEwan. (2020). Retrofitting EV Chargers into a Multifamily Building: The Merits of a 100-per-cent EV-Ready Approach. Retrieved from https://electricautonomy.ca/2021/02/11/multifamily-building-ev-retrofit/

OPPORTUNITIES	CHALLENGES
Less expensive per parking stall compared to incremental retrofits.	High upfront costs are a barrier.
Future-proofs the building and supports EV uptake.	May face more opposition from MURB strata corporations due to the cost of the project.
More energy efficient than incremental retrofits.	
Requires one single construction project instead of multiple ongoing projects.	
More convenient for EV drivers and condo corporations/ landlords.	
here are more rebates available for EV-Ready retrofits.	

Table 5 – Benefits and challenges of installing EV retrofits in 100% of parking stalls in a MURB

Incremental EV Charging Retrofits

Standalone/ Incremental EV Charging Retrofits

Incremental EV charging retrofits involve a building adding one or a few charging stations at a time. This method of increasing access to charging has some benefits, including a lower upfront cost, but is overall less efficient than EV-Ready building retrofits. If buildings choose to do incremental retrofits, there may not be sufficient electrical power to support future charging stations. This is unfair to late adopters of EVs and would not effectively future-proof the building when demand for EV charging increases. Furthermore, incrementally adding new charging stations requires more construction, more paperwork and planning, and more effort from the building's strata council or landlord. This is inconvenient and will likely increase costs due to additional planning. Incremental charging retrofits also have fewer funding opportunities compared to 100% retrofits (*See Table 6*) and a higher cost per stall.[63]

Although 100% retrofits are generally more efficient than incremental retrofits, adding one or a few charging stations to a building can be a successful short-term solution for supporting EV drivers. However, this method requires the charging stations to be accessible by all residents and should be followed by EV-Ready retrofits when possible.

[63] Brendan McEwan. (2020). Retrofitting EV Chargers into a Multifamily Building: The Merits of a 100-per-cent EV-Ready Approach. Retrieved from https://electricautonomy.ca/2021/02/11/multifamily-building-ev-retrofit/

OPPORTUNITIES	CHALLENGES
Lower upfront costs.	Higher cost per stall.
Can be a successful short-term solution if installed in common areas.	There may not be sufficient electrical capacity in the building to support future retrofits. This does not effectively future-proof the building.
	Concerns about fairness and who gets access to stalls with EV charging capability.
	More paperwork, construction, and discussions by the strata council are required.
	Fewer funding opportunities compared to 100% retrofits.

Table 6 – Benefits and challenges of installing incremental EV retrofits in MURBs

Shared use charging infrastructure (Retrofits)

One short-term solution for providing at-home charging to people living in MURBs is installing a small number of EV chargers in common parking areas such as visitor parking or shared parking. This option works best while EV adoption rates are low and may incentivize EV uptake for building residents.[64] This solution will also allow more time for strata councils and buildings managers to plan for future EV retrofits; However, this solution will not be sufficient to meet the demand for EV charging as uptake increases.

Providing EV charging in visitor parking alleviates problems such as equipment ownership, non-exclusive use of parking stalls, and concerns about fairness. If a MURB manager installs a common-use charging station, they may charge user fees to ensure building residents are not paying for a service that they do not use.[65] Installing networked EV chargers allows residents to access information about station time limits, waitlists, and infrastructure status. This technology is commonly used for public chargers to track energy usage and manage payments.[66] Pollution Probe recommends that MURBs install EV charging stations that can accommodate multiple vehicles at a time.[67] This requires access to at least two shared parking spaces and can involve EVEMS to reduce pressure on the building's electrical network. Shared use charging retrofits are less expensive if they are located close to the building's electrical room.[68] If parking spaces in the

[64] Interview with Jennifer Neville, Lawyer, Hamilton & Company. (2021).
[65] Interview with Jennifer Neville, Lawyer, Hamilton & Company. (2021).
[66] Pollution Probe & Delphi Group. (2020). Guide to Electric Vehicle Charging in Multi-Unit Residential Buildings. Retrieved from https://www.pollutionprobe.org/wp-content/uploads/Guide-to-EV-Charging-in-MURBS-PDF.pdf pp. 60
[67] Pollution Probe & Delphi Group. (2020). Guide to Electric Vehicle Charging in Multi-Unit Residential Buildings. Retrieved from https://www.pollutionprobe.org/wp-content/uploads/Guide-to-EV-Charging-in-MURBS-PDF.pdf pp. 60
[68] Pollution Probe & Delphi Group. (2020). Guide to Electric Vehicle Charging in Multi-Unit Residential Buildings. Retrieved from https://www.pollutionprobe.org/wp-content/uploads/Guide-to-EV-Charging-in-MURBS-PDF.pdf pp. 60

MURB can be reassigned, it may be beneficial to move EV-networked spaces closer to the building's electrical room. Additionally, installing EV chargers in shared parking spaces may be less expensive than installing curbside chargers outside of MURBs. Buildings with covered or locked parking garages may not need weatherproof or tamper-proof chargers, which are necessary for curbside charging.[69]

CURRENT SUPPORTS FOR MURB RETROFITS AND OPPORTUNITIES FOR THE CITY OF NORTH VANCOUVER

Financial Support for Retrofits

Financial support for purchasing EVs or installing at-home EV charging is one of the most effective incentives to improve EV adoption rates. After federal EV rebates were launched in 2019, EV sales increased by 32 percent compared to the same period in 2018.[70] EV charging infrastructure can be expensive due to the cost of the charger, electric infrastructure, and installation. The federal and BC provincial governments have worked to address this barrier by developing rebate programs for charging in single-family, multi-family, and commercial buildings.

REBATE SOURCE	RETROFIT DESCRIPTION	FUNDING AMOUNT
Clean BC (provided in collaboration with BC Hydro, the province of BC, and FortisBC.)	'**EV Ready' MURB Retrofits:** To encourage 100% or large-scale retrofits, Clean BC offers 3 separate rebates for EV-Ready MURB retrofits.	**EV Ready plan rebate:** Up to $3,000 for developing a professional EV Ready Strategy for the building. **EV Ready infrastructure rebate:** Up to $600 per parking space to install the electrical infrastructure required to implement the EV Ready plan (Maximum $80,000). **EV charger rebate:** Up to $1,400 per charger to purchase and install Level 2 networked EV chargers in the building (Maximum $14,000).[71]
	Standalone MURB Retrofits: Clean BC offers this option for buildings with limited interest or funding available to install EV charging stations.	Up to $2,000 per charger for individual retrofits (maximum $14,000).[72]
Natural Resources Canada (NRCan)	NRCan rebates can be stacked with other federal, provincial, territorial, or municipal funding for up to 75% of the cost of the project for residents, landlords, and businesses.[73]	MURB Rebate: Up to 50% of the total installation costs (maximum $5,000) for Level 2 chargers.[74] Although it is not common, MURBs can also apply for 20kW-49kW fast charger rebates (DCFC) for up to 50% of the total project costs (maximum $15,000).[75]

Table 7 - Rebate options for EV Charging Infrastructure in BC

[69] Interview with Mahdis Araujo, E.V. Advisor, Plug In BC
[70] CBC News. (2020). Federal electric-car rebate uses nearly half its 3-year budget in 8 months. Retrieved from https://www.cbc.ca/news/canada/british-columbia/electric-car-rebate-canada-half-its-3-year-budget-in-8-months-1.5443129
[71] BC Hydro. (n.d.). B.C.'s EV charger rebate program. Retrieved from https://electricvehicles.bchydro.com/incentives/charger-rebates
[72] BC Hydro. (n.d.). B.C.'s EV charger rebate program. Retrieved from https://electricvehicles.bchydro.com/incentives/charger-rebates
[73] Government of Canada. (n.d.) Zero Emission Vehicle Infrastructure Program – News and FAQ. Retrieved from https://www.nrcan.gc.ca/energy-efficiency/transportation-alternative-fuels/zero-emission-vehicle-infrastructure-program/zero-emission-vehicle-infrastructure-program-expression-interest-faq/21878
[74] Government of Canada. (n.d.) Zero Emission Vehicle Infrastructure Program. Retrieved from https://www.nrcan.gc.ca/energy-efficiency/transportation-alternative-fuels/zero-emission-vehicle-infrastructure-program/21876
[75] Government of Canada. (n.d.) Zero Emission Vehicle Infrastructure Program. Retrieved from https://www.nrcan.gc.ca/energy-efficiency/transportation-alternative-fuels/zero-emission-vehicle-infrastructure-program/21876

Financial Support for Rental Unit Retrofits

The City of Vancouver found that rental MURBs are less likely to receive financial support to install EV charging infrastructure compared to MURBs that are owned.[76] This is potentially caused by landlords rejecting tenant applications to install charging infrastructure. This is problematic for the City of North Vancouver because approximately 47% of households live in rental buildings.[77] The City of Vancouver is looking to address this problem by coordinating with Clean BC and landlords to install EV charging stations for renters. In this program, the building landlord applies on behalf of the renters to receive charging infrastructure. The cost to the landlord would be a one-time application fee of approximately $2,000 per building.[78] The City of Vancouver would then pay for the infrastructure and installation of the equipment and apply to BC Hydro for a rebate that would cover half of the installation cost. In this pilot, all of the infrastructure would be owned by the City of Vancouver but would be and operated and maintained by the building landlord.[79] The program is best suited to rental MURBs that are seeking 100% retrofits. Vancouver will only cover up to $190,000 of the installation fee including rebates from BC Hydro, so full-building retrofits will not be financially possible in larger buildings.[80]

The City of Vancouver is planning to run this program as a long-term investment. With the current rates of EV ownership and public charger use, most chargers will not turn a profit. The City recognizes that greater EV adoption will be necessary for charging stations owners to turn a profit and that municipal support will be necessary to allow for these conditions in the future.[81]

Rebate Top-ups

One option to accelerate EV uptake for residents living in MURBs is providing rebate top-ups. Rebate top-ups can supplement the current rebates offered by the federal and provincial governments and make EV charger installation less expensive for residents. The Township of Langley has implemented a rebate top-up program for residences and workplaces that prioritizes MURB retrofits. This program offers up to $1,000 towards eligible costs or 75% of purchase and installation costs (whichever is less) per charging port.[82] There is a $2,000 limit per building, which means that this program supports standalone retrofits over EV-Ready retrofits. These rebates are automatically applied to buildings that are approved for the Clean BC charger rebate program.[83] A similar program was offered in Whistler between 2020 and 2021 that was funded by the Provincial government's Climate Action Revenue Incentive Program.[84] Since both of these programs were recently implemented, there is no public update about their impact on EV uptake in either community.

[76] Interview with Ian Neville, Senior Sustainability Specialist, City of Vancouver. (2021).
[77] City of North Vancouver. (n.d.) Market Rental Housing. Retrieved from https://www.cnv.org/city-services/planning-and-policies/housing/market-rental-housing
[78] Interview with Ian Neville, Senior Sustainability Specialist, City of Vancouver. (2021).
[79] Interview with Ian Neville, Senior Sustainability Specialist, City of Vancouver. (2021).
[80] Interview with Ian Neville, Senior Sustainability Specialist, City of Vancouver. (2021).
[81] City of Vancouver. (2016). Vancouver's EV Ecosystem Strategy. Retrieved from https://vancouver.ca/files/cov/ev-ecosystem-strategy.pdf. pp. 38
[82] Township of Langley. (2021). Electric Vehicle Charger Rebates. Retrieved from https://www.tol.ca/news/electric-vehicle-charger-rebates/
[83] Township of Langley. (2021). Electric Vehicle Charger Rebates. Retrieved from https://www.tol.ca/news/electric-vehicle-charger-rebates/
[84] Resort Municipality of Whistler. (2020). RMOW partnering with BC government for rebates on electric vehicle charging stations. Retrieved from https://www.whistler.ca/media/news/rmow-partnering-bc-government-rebates-electric-vehicle-charging-stations

The Role of the City of North Vancouver in providing Financial Support

Besides marketing Provincial and Federal rebates, the City of North Vancouver may consider providing additional monetary support for the purchase and installation of EV charging infrastructure. This may be done through complete monetary support, such as rebate top-ups, or through partial monetary support such as the rental retrofit program offered by the City of Vancouver. In both cases, the City would need to secure funding and invest in infrastructure to increase the adoption of EVs. The City of Vancouver's model could provide a return on investment if user charges are applied. Rebate top-ops would not provide an opportunity for a return on investment but would support resident-owned charging infrastructure.

CONSIDERATIONS FOR THE CITY OF NORTH VANCOUVER:

1. The City can use Clean BC and NRCAN rebates to decrease installations costs.
2. The City of Vancouver will receive a return on their investment through user fees and potentially by claiming low carbon fuel standard credits. It has not been determined whether Vancouver or BC Hydro should claim fuel standard credits.
3. Providing this service would be a long-term investment. It is unlikely that the City would receive a return on its investment until EV uptake is significantly higher.
4. 47% of City of North Vancouver households rent. If renters face additional barriers to installing EV charging, it will be necessary to provide additional support.
5. Administrative support would not be needed to support resident-owned charging infrastructure. Providing rebate top-ups would be a less involved approach to finically supporting charging infrastructure.

Right to Charge Legislation (Retrofits)

The City has a large number of MURBs that are either owned by strata corporations or leased out by landlords. As outlined in *Section 2*, strata buildings have their own governance system which requires strata members to vote on potential changes to common areas, including the installation of EV charging infrastructure.[85] Pushback or a lack of support from landlords and strata councils can significantly impact access to at-home EV charging for people living in MURBs. This lack of support can sometimes be attributed to worries about liability over the infrastructure and concerns about who pays.[86] Strata acts can be amended at the provincial level to prevent condo boards from restricting or prohibiting EV owners from installing charging infrastructure in their parking spot.[87] This legislation, known as 'Right to Charge' (RTC) legislation, has been successfully implemented in a number of regions in North America including Ontario, California, and Colorado. BC does not currently have RTC legislation; however, it has been included in the province's ministerial mandate letters and may be implemented in BC in the future.[88] Please see *Appendix D* for more detailed information about RTC legislation in these cities. *Table 8* provides a brief overview of this legislation.

[85] BC Laws. (2021). Strata Property Act. Retrieved from https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/98043_04#part4
[86] C2MP & Fraser Basin Council. (n.d.). Residential Electric Vehicle Charging: A guide for local governments. Retrieved from https://www.richmond.ca/__shared/assets/Residential_EV_Charging_Local_Government_Guide51732.pdf. Pp. 26
[87] Pollution Probe & Delphi Group. (2019). Zero Emissions Vehicle Charging in Multi-Unit Residential Buildings and for Garage Orphans. Retrieved from https://www.pollutionprobe.org/wp-content/uploads/ZEV-Charging-in-MURBs-and-for-Garage-Orphans.pdf. Pp. 53
[88] John Horgan. (2020). Letter to Attorney General David Eby. Retrieved from https://www2.gov.bc.ca/assets/gov/government/ministries-organizations/premier-cabinet-mlas/minister-letter/eby_mandate_2020_jan.pdf. Pp. 4

JURISDICTION	KEY TAKEAWAYS
Ontario, Canada	This legislation requires condo corporations to support and approve EV infrastructure applications by: 1) Responding to the tenant's application within 60 days, 2) Providing information and permission to access electrical schematics or the electrical room, and 3) Providing an assessment of the application based on the opinion of a qualified professional. If the application meets legal requirements (such as the Electrical Safety Code), is safe, and will not damage or adversely affect the structural integrity of the condo, the condo corporation may not reject the tenant's application.[89]
California, United States	If the application complies with federal, state, and local law, applicable zoning requirements, land use requirements, and other restrictions, it must be approved by the strata or landlord.[90] The lessor is protected from liability and damages through a written agreement with the lessee that outlines the role of the lessee, including paying for all costs associated with the EV infrastructure, maintaining insurance, and removing the charging station after use as agreed upon with the property owner.[91] This bill applies to both residential and commercial properties that have specified parking areas.
Florida, United States	Infrastructure may only be installed within the boundaries of the applicant's common element parking area and must comply with electrical and architectural safety standards.[92] Applicants must pay for all costs, including installation, operation, maintenance, and insurance of the EV infrastructure. The condominium association has the power to influence the size and appearance of the infrastructure, as long as these requirements still allow for the charger to be installed.[93]

Table 8 - Right to Charge legislation key takeaways

While these bills reduce some barriers to EV charging, they do not pave the way for developing a strong charging network for people living in MURBs. RTC legislation will allow residents to install an EV charging station in their parking spot, but this may result in similar issues as incremental building retrofits. This becomes an issue of fairness as early adopters may have access to charging infrastructure while late adopters may not have the opportunity.[94] British Columbia is currently in the process of developing RTC legislation, which may take a similar form as the case studies identified above and will require significant changes to BC's Strata Property Act.

One of the main factors causing EV charging infrastructure applications to be denied is the lack of knowledge about costs and fairness.[95] The City of North Vancouver can support retrofits by educating residents and building owners about RTC legislation when it is implemented and by marketing the importance and benefits of EV-Ready retrofits over standalone retrofits.

[89] Province of Ontario. (n.d.) Owning a Condo. Retrieved from https://www.ontario.ca/page/owning-a-condo
[90] California Legislative Information. (2014). AB-2565 Rental Property: electric vehicle charging stations. Retrieved from https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201320140AB2565
[91] California Legislative Information. (2014). AB-2565 Rental Property: electric vehicle charging stations. Retrieved from https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201320140AB2565
[92] The Florida Legislature. (2020). The 2020 Florida Statutes. Retrieved from http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&Search_String=&URL=0700-0799/0718/Sections/0718.113.html
[93] The Florida Legislature. (2020). The 2020 Florida Statutes. Retrieved from http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&Search_String=&URL=0700-0799/0718/Sections/0718.113.html
[94] Interview with Jennifer Neville, Lawyer, Hamilton & Company. (2021).
[95] Interview with Jennifer Neville, Lawyer, Hamilton & Company. (2021).

CONSIDERATIONS FOR THE CITY OF NORTH VANCOUVER:

1. RTC legislation may incentivize incremental retrofits over 100% or group retrofits. This may cause problems with future-proofing, which would be counterproductive. Educating residents about the importance and benefits of EV-Ready Retrofits may become more important as RTC legislation is implemented.

2. Preparing guidance and education materials may support residents and strata owners with the changes caused by Right to Charge legislation.

3. Some jurisdictions, such as California, have RTC legislation for both residential and commercial buildings. Advocating to include commercial buildings may improve public charging access in the future.

4. Before this legislation is implemented in BC, the City of North Vancouver can support MURB retrofits by providing guidance materials to reduce misconceptions and concerns about EV charging infrastructure.

Unbundling Parking Spaces (Retrofits)

Similar to shared-use EV charging, buildings can offer EV charging to a smaller number of drivers by unbundling the parking stalls and offering EV charging in a limited number of stalls. The term 'unbundled parking' refers to a parking space that is rented or sold separately from a dwelling unit.[96] This allows residents to choose if they want a parking space and potentially whether they want a parking space that has the infrastructure to support EV charging. Parking stalls could initially be reassigned so that the stalls closest to the building's electrical room are equipped with EV charging infrastructure. Residents could then rent one of the EV charging stalls if desired. Parking unbundling is most commonly applied to new buildings, but can also be implemented in existing buildings. The group 'Portlanders for Parking Reform' argues that adding parking unbundling to existing affordable housing units will help free up more of their budget for housing.[97] This could be a viable option to support access to EV charging for residents who own or plan to own an EV in the future.

Unbundling parking is a fairly new and uncommon practice, with only a few examples in Canada and the United States. Unbundling is typically used in areas with a strong public transportation system to reduce rental prices for people who do not own a vehicle. For example, an apartment building close to the Metrolinx transit system in St. Louis offered unbundled parking spaces and 20-25% of buyers opted out of purchasing a stall.[98] In a similar fashion, MURBs that offer unbundled parking could allow residents to opt for no parking, regular parking, or a parking stall with EV charging infrastructure. *Table 9* shows some benefits and detriments associated with unbundling parking to provide EV charging.

[96] City of Mississauga. (2015). Parking Matters Appendix 1-1 Current Trends in Planning and Managing Parking. Retrieved from https://www.mississauga.ca/wp-content/uploads/2020/01/29101002/Parking-Master-Plan-Appendices.pdf pp. 6
[97] Portlanders for Parking Reform. (2016). Diversifying Portland's Parking Toolkit with Unbundling Parking and Parking Cash Out. Retrieved from https://pdxshoupistas.com/diversifying-portlands-parking-toolkit-with-unbundling-parking-and-parking-cash-out/
[98] City of Mississauga. (2015). Parking Matters Appendix 1-1 Current Trends in Planning and Managing Parking. Retrieved from https://www.mississauga.ca/wp-content/uploads/2020/01/29101002/Parking-Master-Plan-Appendices.pdf pp. 83

OPPORTUNITIES	CHALLENGES
• Charger utilization would be higher if residents chose a space with EV charging. This can help the building receive a return on its investment through user fees.[99] • Multiple residents would be able to access EV charging at the same time. • Residents could charge their vehicles overnight. • 100% building retrofits would not be necessary. • Charger congestion would not be a problem. • If buildings charge more for EV-Ready parking spaces, they can finance installation and maintenance costs. • Building owners could potentially lease out extra parking spaces or offer public EV charging to non-residents of the building.	• Providing this option may incentivize incremental EV retrofits. This reduces the ability of buildings to install more charging stations in the future due to limited electrical capacity. • Demand for these parking spaces may exceed supply in the future. • Some residents may purchase or rent EV-Ready parking space when they do not have an EV (potentially due to having multiple vehicles). This will remove charging stations from other residents. • This solution would most likely be applied in new buildings and therefore would not improve access to EV charging for people living in existing MURBs.

Table 9 - Benefits and detriments of parking unbundling for EV charging purposes

The City of North Vancouver may explore the opportunity to implement parking unbundling in new and existing buildings at the municipal level. This could allow new residents to choose if they want a parking space with EV charging infrastructure and potentially restructure existing parking lots to allow current residents to choose whether they want a spot with EV charging infrastructure. This method of providing access to at-home charging would only provide charging to residents who need it, instead of having the infrastructure go unused for years by residents without EVs.

EV Education for MURBs

Lack of education and misconceptions about EV charging were identified as significant barriers by multiple interviewees and during the best practices research conducted for this report. One of the primary misconceptions about EV charging regards the price and fairness of charging infrastructure in MURBs. Lack of education and misconceptions reduce EV uptake and can result in pushback from building owners when residents ask to install at-home charging infrastructure. This problem must be addressed in order to support EV uptake and building retrofits.

There are a number of municipalities and organizations that provide education about EV charging in MURBs including Plug-In BC, BC Hydro, Metro Vancouver, and Natural Resources Canada. Municipalities such as Saanich and Vancouver have identified education as the next step in their EV transportation plans and are working to develop education and awareness campaigns. Please see *Appendix E* for a more detailed overview of these education and awareness programs.

[99] Parkade. (2020). Should EV chargers be put in assigned or communal parking spots? Retrieved from https://parkade.com/post/should-ev-chargers-be-put-in-assigned-or-communal-parking-spots

ORGANIZATION	EDUCATIONAL SUPPORT
Plug-In BC & BC Hydro	Online guidelines about the selection, installation, and maintenance of EV Charging infrastructure. Online guidelines for requesting to install infrastructure (directed at landlords and strata councils). Information about rebates and other funding opportunities.
Metro Vancouver	The EV Strata Condo webpage provides guidance for EV owners, strata councils, and property managers about installing EV charging infrastructure.
Natural Resources Canada	NRCAN developed the Zero Emissions Vehicle Awareness Initiative (ZEVAI) to improve education and awareness about EVs and EV charging in Canada. This initiative provides funding for governments and businesses to support innovative knowledge-sharing projects. Provincial, regional, and municipal governments can receive funding up to 75% of the total project cost.[100] This funding opportunity closes on August 16, 2021. Like other NRCan funding opportunities, this one may be offered again in the future.
Emotive	Emotive is an EV outreach and education program run by the Province of BC that offers EV education events, videos, and written guides about owning an EV.[101] Emotive has a Community Outreach Program (COIP) that offers support and funding to BC communities, organizations, and municipalities to assist with developing and delivering EV awareness campaigns.[102] The funding is intended to help deliver Emotive campaign activities including general awareness events and clean transportation planning.[103] The program offers three levels of funding, including: • $5,000 for EV outreach activities. • $10,000 for campaigns that span across multiple communities. • $20,000 for indigenous governments to develop clean transportation targets, plans, and policies that will be incorporated into public-facing strategic documents.[104]
MUNICIPALITY	**EDUCATIONAL SUPPORT**
Saanich	Identified promotional and educational events including ‘ride and drive’ events as a high priority in their 2020 EV strategy.[105] Developing a communications campaign that will include: • Short videos, testimonials, presentations, sound-bytes, and informative posters that outline the benefits of EVs; • Media promotion of EVs and the City’s charging network; and • Support for car dealerships to have EVs available for test drives.[106] Planning to provide EV charging infrastructure education and resource materials to strata councils/members, rental apartment building owners and the Vancouver Island Strata Owners Association to support EV charging in existing MURBs. [107]

[100] Government of Canada. (2021). Zero Emissions Vehicle Awareness Initiative. Retrieved from https://www.nrcan.gc.ca/energy-efficiency/transportation-alternative-fuels/electric-and-alternative-fuel-infrastructure/zero-emission-vehicle-awareness-initiative/22209
[101] Emotive. (n.d.) Live the Electric Vehicle Life. Retrieved from https://www.emotivebc.ca/
[102] Plug In BC. (2021). Emotive Community Outreach Incentive Program. Retrieved from https://pluginbc.ca/community-outreach-incentive-program-2021/
[103] Plug In BC. (2021). Emotive Community Outreach Incentive Program. Retrieved from https://pluginbc.ca/community-outreach-incentive-program-2021/
[104] Plug In BC. (2021). Emotive Community Outreach Incentive Program. Retrieved from https://pluginbc.ca/community-outreach-incentive-program-2021/
[105] District of Saanich. (2020). Electric Mobility Strategy. Retrieved from https://www.saanich.ca/assets/Community/Documents/Planning/sustainability/E-Mobility-Strategy-web.pdf pp. 43
[106] District of Saanich. (2020). Electric Mobility Strategy. Retrieved from https://www.saanich.ca/assets/Community/Documents/Planning/sustainability/E-Mobility-Strategy-web.pdf pp. 43
[107] District of Saanich. (2020). Electric Mobility Strategy. Retrieved from https://www.saanich.ca/assets/Community/Documents/Planning/sustainability/E-Mobility-Strategy-web.pdf pp.46

Vancouver	The City identified two primary actions to improve awareness in this plan, including: 1) Developing a workplace charging challenge. The workplace charging challenge involves the creation of an information campaign that targets employers and building managers in commercial properties to expand EV charging access.[108] The goal is to improve the public charging network by explaining the benefits of providing EV charging. This program has not yet been implemented in Vancouver. 2) Installing 'EHubs' with highly visible designs that can be used as canvases for information and public art.[109] The unique designs will increase awareness of these stations and information boards at the charging sites can outline the benefits of EV ownership. Improving the visibility of public charging stations will decrease concerns about limited charging stations.

Table 10 - EV education programs and guidelines

The City of Vancouver developed a support system to expedite the permitting process for publicly accessible EV charging stations. The US Department of Energy has also written a guide for businesses and policymakers on implementing public charging stations. *Table 11* outlines the key takeaways for both of these initiatives. Please see Appendix F for more detailed information about these programs and guidelines.

EDUCATIONAL OPPORTUNITY	CITY OF NORTH VANCOUVER'S ROLE
Running 'ride and drive' events	Collaborate with Emotive or apply for Emotive's COIP funding to host municipal EV awareness events. This will provide an opportunity for residents to test an EV and ask questions about costs and infrastructure. These events can be geared towards MURB residents and building owners.
Media promotion of short videos testimonials, posters, or presentations.	Work with the City's communications team to promote EV education materials on the City's website, Facebook, or Twitter. Work with the local newspaper to promote educational materials about the benefits of EV retrofits in MURBs.
Develop and share directed information guides	Develop or use existing guidance materials and share them with MURBs owners, strata councils, residents, etc.
Open house presentations and surveys.	Analyze the current level of awareness and interest in EV ownership through open house presentations and surveys. Open houses can provide information and allow residents to ask questions. This type of event could be geared towards MURB residents or building owners.
Develop highly visible public charging stations.	The City's existing EV charging stations are generally low profile with minimal signage. There is an opportunity to collaborate with local artists or to install informational boards at EV charging stations that are located in easily accessible areas to improve visibility and educate residents about the purpose of the stations and benefits of EVs. Public charging stations can supplement MURBs that do not have charging infrastructure.

Table 11 - Educational programs to be considered by the City of North Vancouver

[108] City of Vancouver. (2016). Vancouver's EV Ecosystem Strategy. Retrieved from https://vancouver.ca/files/cov/ev-ecosystem-strategy.pdf pp. 34
[109] City of Vancouver. (2016). Vancouver's EV Ecosystem Strategy. Retrieved from https://vancouver.ca/files/cov/ev-ecosystem-strategy.pdf pp. 44

ON-STREET CHARGING OPPORTUNITIES

Residents living in MURBs face many barriers to accessing at-home EV-Charging infrastructure including push-back from landlords or strata's, lack of electric grid capacity, and costs. Due to these barriers, it is important for the City of North Vancouver to provide a variety of public charging options to supplement the lack of at-home charging for these residents. Supporting on-street public charging can be in the form of a public-private partnership (PPP) or through other administrative or educational programs.

Potential for non-property owners to install EV charging stations in front of their businesses

Some municipalities have tried to improve public charging by supporting public charging infrastructure in front of businesses. This type of program allows non-property owners to install EV chargers on the curb in front of their business, with either financial or administrative support from the local government. Providing public charging can be a benefit for businesses by attracting customers and providing added revenue through user charging fees. *Table 11* explains some of the benefits of installing public EV chargers in front of a business.

BENEFITS OF INSTALLING EV CHARGING IN FRONT OF BUSINESSES	
Attracts customers	The majority of EV drivers spend money at their destination while they wait for their vehicle to charge.[110] Due to the fairly limited network of public charging stations in the City of North Vancouver, all new charging stations will likely be in high demand. This provides an opportunity for businesses to generate additional revenue.[111]
Business exposure & branding	Public charging stations are often listed on free websites such as PlugShare. Networked charging stations are listed on related phone apps and websites.[112] These sites allow businesses to market their charging stations for free. Additionally, providing EV charging helps establish a business as a sustainability leader.[113]
Increased revenues	Businesses can get a return on their investment by charging user fees for their charging equipment. If demand is high enough, businesses may be able to profits off of EV charging.

Table 12 - Benefits of EV charging for businesses

The City of Vancouver developed a support system to expedite the permitting process for publicly accessible EV charging stations. The US Department of Energy has also written a guide for businesses and policymakers on implementing public charging stations. *Table 13* outlines the key takeaways for both of these initiatives. Please see Appendix F for more detailed information about these programs and guidelines.

[110] Flo. (n.d.) EV charging solutions for retail stores and restaurants. Retrieved from https://www.flo.com/en-CA/business/industries/retail-stores-restaurants/
[111] Flo. (n.d.) EV charging solutions for retail stores and restaurants. Retrieved from https://www.flo.com/en-CA/business/industries/retail-stores-restaurants/
[112] ChargePoint. (n.d.). You've made the smart decision to go electric. Retrieved from https://www.chargepoint.com/solutions/retail/
[113] ChargePoint. (n.d.). You've made the smart decision to go electric. Retrieved from https://www.chargepoint.com/solutions/retail/

JURISDICTION	KEY TAKEAWAYS
Vancouver, Canada **(Pilot program)**	The City of Vancouver ran a pilot program in 2018 to provide administrative support for businesses to install EV chargers on City-owned land. Businesses that signed up for the program paid for all installation fees and a $200 licensing fee. In return, the business was not required to obtain a building or development permit for the installation of the charging infrastructure.[114] Participating buildings were still required to obtain an Electrical Permit from the Permits and Licensing Office.[115] These charging stations were required to be publicly accessible and free-use, meaning that the business could not sell the use of electricity, as stipulated under the Utilities Commission Act.[116] One of the main barriers to uptake was the cost of the infrastructure. Since businesses were not allowed to charge fees for use of their charging stations, they were unable to recoup the cost of their investment.[117] However, the Utilities Commission Act (UCA) was amended to allow for the resale of electricity by businesses in March 2019.
U.S. Department of Energy **(Guidelines)**	Providing EV charging can improve financial performance by increasing sales and business exposure, but may have a long payback period due to low EV adoption rates.[118] As EV adoption increases, the payback period will continue to improve; however, limited revenue gain is currently a disincentive for businesses to install EV charging infrastructure. In the short term, it is necessary for municipal and state/provincial governments to provide interventions such as grants, loans, and other incentives that encourage residents to purchase EVs and businesses to provide EV charging. One opportunity in BC would be to collaborate with the credit union, Vancity, which often supports local sustainability initiatives.[119] In fact, Vancity has an environmental commitment to provide funding for governments to implement public policy that reduces negative environmental impacts.[120] **Sales boost business model** –Automakers should provide a small amount of funding for businesses to install EV charging infrastructure.[121] Companies that produce EVs will benefit from public EV charging because it encourages uptake and results in more profits. This model would require strong support from the federal government and may result in an increase in EV prices. However, EV automakers including Nissan, BMW, and Volkswagen have all subsidized DCFC charging in the past, suggesting that automakers may be receptive to offering additional subsidies.[122] **Revenue sharing business mode**l – This model recommends that a group of businesses in close proximity to each other should either equally invest in a charging station and share the profits or send a portion of their increased sales profits to the station owner on an annual basis.[123] Charging stations are a benefit to all businesses in the area, especially if they are located in a popular tourist destination. While drivers wait for their vehicle to charge, they will shop or dine at the local stores, restaurants, and cafes and increase revenues in these businesses. Businesses involved in this model would also receive direct revenues from charging service fees.[124] Depending on the demand for the station, this business model could provide a better return on investment for all shops involved.

Table 13 - Methods to support EV charging in front of businesses

[114] City of Vancouver. (2018). CURBSIDE ELECTRIC VEHICLE SUPPLY EQUIPMENT PILOT PROGRAM GUIDELINES. Retrieved from https://vancouver.ca/files/cov/curbside-evse-pilot-guidelines.pdf pp. 1
[115] City of Vancouver. (2018). CURBSIDE ELECTRIC VEHICLE SUPPLY EQUIPMENT PILOT PROGRAM GUIDELINES. Retrieved from https://vancouver.ca/files/cov/curbside-evse-pilot-guidelines.pdf pp. 6
[116] City of Vancouver. (2018). CURBSIDE ELECTRIC VEHICLE SUPPLY EQUIPMENT PILOT PROGRAM GUIDELINES. Retrieved from https://vancouver.ca/files/cov/curbside-evse-pilot-guidelines.pdf pp. 3
[117] Interview with Ian Neville, Senior Sustainability Specialist, City of Vancouver. (2021).
[118] Center for Climate and Energy Solutions. (2015). Strategic Planning to Implement Publicly available EV charging stations: A guide for businesses and policymakers. Retrieved from https://www.c2es.org/site/assets/uploads/2015/11/strategic-planning-implement-publicly-available-ev-charging-stations-guide-businesses.pdf pp. vii
[119] Interview with Brendan McEwan, AES Engineering. (2021).
[120] Vancity. (2021). Environmental Sustainability. Retrieved from https://www.vancity.com/AboutVancity/VisionAndValues/ValuesBasedBanking/EnvironmentalSustainability/
[121] Center for Climate and Energy Solutions. (2015). Strategic Planning to Implement Publicly available EV charging stations: A guide for businesses and policymakers. Retrieved from https://www.c2es.org/site/assets/uploads/2015/11/strategic-planning-implement-publicly-available-ev-charging-stations-guide-businesses.pdf pp. xi
[122] Center for Climate and Energy Solutions. (2015). Strategic Planning to Implement Publicly available EV charging stations: A guide for businesses and policymakers. Retrieved from https://www.c2es.org/site/assets/uploads/2015/11/strategic-planning-implement-publicly-available-ev-charging-stations-guide-businesses.pdf pp. 27
[123] Center for Climate and Energy Solutions. (2015). Strategic Planning to Implement Publicly available EV charging stations: A guide for businesses and policymakers. Retrieved from https://www.c2es.org/site/assets/uploads/2015/11/strategic-planning-implement-publicly-available-ev-charging-stations-guide-businesses.pdf pp. ix
[124] Center for Climate and Energy Solutions. (2015). Strategic Planning to Implement Publicly available EV charging stations: A guide for businesses and policymakers. Retrieved from https://www.c2es.org/site/assets/uploads/2015/11/strategic-planning-implement-publicly-available-ev-charging-stations-guide-businesses.pdf pp. 30

The Role of the City of North Vancouver in Increasing On-Street Charging Opportunities

The City can support public on-street EV charging stations by financially or administratively supporting businesses in the installation of charging infrastructure. Financial support may be City funding for EV stations, as in the City of Vancouver, or through non-direct financial support such as no or low-interest loans, as suggested by the US Department of Energy. Administrative funding may include the development of streamlined application processes for the installation of EV charging stations, such as the one developed by the City of Vancouver. Education campaigns directed at businesses can also increase interest in providing EVs by outlining the potential benefits to businesses.

CONSIDERATIONS FOR THE CITY OF NORTH VANCOUVER:

1. Government funding and other assistance may be necessary before it will be profitable for businesses to install EV charging stations.
2. Financial support is a good incentive but is not required to increase public charging stations. Administrative support can expedite the process and make installation less complicated for businesses.
3. Partnering with Vancity or another financial institution can provide indirect financial support for businesses. For example, developing a low or no-interest loan program for EV charging infrastructure can make the process more financially feasible for businesses.
4. If EV uptake is high enough, charging stations could become profitable. It may be beneficial to develop educational materials for businesses about the benefits and revenue models they could implement.
5. BC legislation is being changed to better accommodate public EV charging stations. Programs similar to the one piloted in Vancouver may be easier to implement in the future.

On-Street EV Charging Adjacent to New Residential Developments

The City of North Vancouver requires all parking spaces in new residential buildings have an energized charging outlet capable of providing level 2 EV charging.[125] This policy will support EV charging in the future but does not support residents who live in older buildings. One method to increase access to EV charging is to encourage or require new developments to provide publicly accessible, on-street charging stations in addition to the private stations installed in resident parking lots. This method of improving the public charging network has been implemented in Vancouver, which was based on a similar program designed to support existing MURBs in Amsterdam.

Vancouver: The City of Vancouver introduced a requirement for large new developments to provide EV charging stations adjacent to new developments 3-4 years ago. These on-street stations are considered during the re-zoning of developments that are greater than 10 acres in size.[126] Stations built under this program will be funded by the developer and run by the City of Vancouver.

[125] Plug In BC. (n.d.) Electric Vehicle Policies. Retrieved from https://pluginbc.ca/policy/
[126] Interview with Ian Neville, Senior Sustainability Specialist, City of Vancouver. (2021).

Due to the development size outlined in this program, there has been nothing built with these requirements in place. The first location in Vancouver that includes these regulated EV charging stations will likely be the Plaza of Nations.[127] Vancouver is considering the implementation of on-request charging infrastructure, which is a program based in Amsterdam.[128]

Amsterdam: Amsterdam has put a significant focus on improving its public charging network to increase EV adoption and reduce range anxiety. The City uses an on-demand process for installing EV charging, in which any resident can apply to have a charging station installed in front of their house as long as it will be publicly accessible.[129] The cost of the infrastructure and installation is completely covered by the City and they receive a return on investment through user fees.[130] Each application goes through a 10-step process to ensure the charging station is being installed in a beneficial area. This program has a significantly higher cost compared to Vancouver's program; however, it is available for both new and old developments and ensures that the chargers will be installed where they are needed.

The Role of the City of North Vancouver in supporting EV charging adjacent to new developments

To support public EV charging next to new developments, the City would need to amend the bylaw which requires new developments to be 100% EV ready to include public charging stations. Given the size of the City, the 10-acre minimum used by the City of Vancouver may not be effective in expanding the public charging network, as it is unlikely that many developments of that size will occur. If the City follows Amsterdam's approach of on-demand EV charging stations, funding will be necessary to support the program. This program would likely be more frequently requested from existing buildings, as new buildings must follow the EV-Ready bylaw.

CONSIDERATIONS FOR THE CITY OF NORTH VANCOUVER:

1. Since the City already has a bylaw that requires new residential developments to be 100% EV ready, it may not be a complex process to amend this process. The City could require new developments of a certain size to provide public on-street charging. This will support and grow the public charging network as EV use increases over the next few decades.

2. It is unlikely that many future developments in the City of North Vancouver will be greater than 10 acres in size. If the City follows Vancouver's program, the development size may need to be reduced.

3. If public charging stations are owned by the City, it may be easier to ensure that stations are operational and being maintained.

4. The City of North Vancouver may also consider implementing on-demand public charging infrastructure to support neighbourhoods without at-home charging. This program would be costly, but the City could receive a return on investment if user charges are applied. A process would need to be developed to determine which locations should receive charging infrastructure. This may be similar to the 10-step process used in Amsterdam.

[127] Interview with Ian Neville, Senior Sustainability Specialist, City of Vancouver. (2021).
[128] Interview with Ian Neville, Senior Sustainability Specialist, City of Vancouver. (2021).
[129] CNN Business. (2019). Amsterdam is using freebies to help ban polluting cars by 2030. Retrieved from https://www.cnn.com/2019/05/03/business/amsterdam-electric-cars/index.html
[130] CNN Business. (2019). Amsterdam is using freebies to help ban polluting cars by 2030. Retrieved from https://www.cnn.com/2019/05/03/business/amsterdam-electric-cars/index.html

EV Charging through streetlight infrastructure

Another method of improving the public charging network is retrofitting streetlight poles that have been upgraded to LEDs with EV charging infrastructure. Streetlight poles are connected to a dedicated electrical network that can provide enough power to support level 2 EV charging if the bulbs are LEDs. This method of charging has been implemented or proposed in a number of cities to improve the public charging network. Please *see Appendix G* for more detailed information about streetlight pole charging in these cities.

JURISDICTION	PROGRAM FOR EV CHARGING USING STREETLIGHTS
New Westminster	Developed a pilot program with The British Columbia Institute of Technology BCIT to provide EV charging for garage orphans. Areas of the city that had LED streetlights often either had off-street residential parking or poles that were placed on the far side of the sidewalk from the road.[131] Streetlight poles that were chosen for the program had to receive LED retrofits, occasional wire upgrades, and occasional branch breaker upgrades.[132] Each charging station cost approximately $4,000 CAD and included EVEMS technology and a retractable cord.[133] These technologies were chosen to ensure that the electrical capacity of the light service panel would not be overloaded during peak hours.
California	The California Bureau of Street Lighting installed EV charging infrastructure on 431 LED streetlights in Los Angeles to date.[134] Streetlight poles were chosen to host EV charging equipment to limit the amount of infrastructure built on the sidewalk.[135] EV charging stations in Los Angeles are heavily subsidized through grants from the California Air Resources Board and the California Energy Commission.[136]
Toronto	The City of Toronto worked with Toronto Hydro to plan for the installation of 6 public EV streetlight charging stations. The areas chosen for this project were identified based on the availability of parking permits, parking restrictions, the presence and location of streetlight poles, the ability for two cars to park end-to-end, and the available electrical capacity.[137] EVs using these stations will be required to follow all posted parking restrictions, including time limits. The City of Toronto implemented site-specific bylaw amendments to limit parking in unregulated areas to 12 hours.[138]

[131] Howey, Clay. (2018). Innovations in Electric Vehicle Charging – EV Infrastructure Project: Siting Considerations. Retrieved from https://www.bcit.ca/files/appliedresearch/pdf/2-evi-workshop-02-22-2017-siting.pdf
[132] Howey, Clay. (2018). Innovations in Electric Vehicle Charging – EV Infrastructure Project: Siting Considerations. Retrieved from https://www.bcit.ca/files/appliedresearch/pdf/2-evi-workshop-02-22-2017-siting.pdf
[133] Puentes, Andres. (2019). On-Street Electric Vehicle Charging from Light Poles. Retrieved from https://sustain.ubc.ca/sites/default/files/2019-60_On-Street%20Electric%20Vehicle%20Charging_Puentes.pdf pp.18
[134] City of Los Angeles. (2020). EV Charging Stations. Retrieved from http://bsl.lacity.org/smartcity-ev-charging.html
[135] Electrek. (2019). LA adds hundreds of EV chargers to streetlights, giving renters a place to plug in. Retrieved from https://electrek.co/2019/11/13/la-adds-hundreds-of-ev-chargers-to-streetlights-giving-renters-a-place-to-plug-in/
[136] Electrek. (2019). LA adds hundreds of EV chargers to streetlights, giving renters a place to plug in. Retrieved from https://electrek.co/2019/11/13/la-adds-hundreds-of-ev-chargers-to-streetlights-giving-renters-a-place-to-plug-in/
[137] City of Toronto. (2018). Residential On-Street Electric Vehicle Charging Stations – Parking Amendments – Delegated Locations. Retrieved from https://www.toronto.ca/legdocs/mmis/2018/te/bgrd/backgroundfile-115559.pdf pp. 3
[138] City of Toronto. (2018). Residential On-Street Electric Vehicle Charging Stations – Parking Amendments – Delegated Locations. Retrieved from https://www.toronto.ca/legdocs/mmis/2018/te/bgrd/backgroundfile-115559.pdf pp. 4

Vancouver	The City of Vancouver is analyzing the opportunity to install streetlight pole charging for a carshare programs and potentially for public charging in the future.[139] This program would be aligned with the City's plans to add LED retrofits to older streetlights, which will decrease the electrical load of the poles by approximately 50% and provide enough power to support level 2 EV chargers.[140] The City may need to upgrade the insulation, grounding system, metallic conduit, and service panels of many of the poles to support EV charging.[141] Some streetlight poles are only energized at night, which would significantly limit the number of drivers able to use the charging service.

Table 14 - Streetlight pole EV charging

Opportunity in The City of North Vancouver

Adding EV charging stations to streetlight poles has not previously been implemented by cities using BC Hydro polls because the current fee rate structure makes it unfeasible. Cities that use BC Hydro streetlights are given a specific rate for energy use that is based on the number of streetlight poles used in the city. The majority of streetlights are not metered, which means that BC Hydro would not be able to measure the additional electricity used from EV charging. Despite this barrier, the City of Vancouver is working with BC Hydro to develop a streetlight pole pilot project that will involve adding metering devices to the poles.

This opportunity for on-street EV charging should be further analyzed in the City of North Vancouver because it would provide more options for the City to provide public charging. Streetlight pole charging may also be applied in specific neighbourhoods that lack access to at-home charging. There are many challenges and opportunities related to streetlight pole charging (*see Table 15*); however, it can be less expensive, less obtrusive, and less complex than other curbside charging methods. This project would require support and collaboration with BC Hydro. The City of North Vancouver should follow the process of streetlight charger implementation in Vancouver and communicate with BC Hydro about feasibility in the City.

OPPORTUNITIES	CHALLENGES
• Streetlight poles are attached to a dedicated electrical circuit. • EVEMS can be used to ensure that the power is prioritized for streetlights during the night. • Other cities have successfully provided EV charging in this way. • Can be a lower cost if the light pole is new or if trenching is timed with streetlight upgrades.[142] • Attaching EV chargers to streetlights can reduce 'clutter on the curb and make more space for pedestrians, seating, and greenery.	• Streetlight pole charging has not been implemented in municipalities using BC Hydro poles due to lack of energy use metering. • There is a lot of competition for the curbside. It may be difficult to balance cyclists, pedestrians, roadside greenery, and EV charging cords. • Streetlight poles must be on the side of the sidewalk that is closest to the road. • Poles chosen for EV chargers must be close to the electrical box and contain LED bulbs. • Retrofitting streetlight poles with EV charging may be cost-prohibitive. • Old infrastructure may need to be replaced.

Table 15 - Challenges and opportunities with streetlight pole EV charging

[139] Interview with Ian Neville, Senior Sustainability Specialist, City of Vancouver. (2021).
[140] Puentes, Andres. (2019). On-Street Electric Vehicle Charging from Light Poles. Retrieved from https://sustain.ubc.ca/sites/default/files/2019-60_On-Street%20Electric%20Vehicle%20Charging_Puentes.pdf pp. 19
[141] Puentes, Andres. (2019). On-Street Electric Vehicle Charging from Light Poles. Retrieved from https://sustain.ubc.ca/sites/default/files/2019-60_On-Street%20Electric%20Vehicle%20Charging_Puentes.pdf pp. 27
[142] Puentes, Andres. (2019). On-Street Electric Vehicle Charging from Light Poles. Retrieved from https://sustain.ubc.ca/sites/default/files/2019-60_On-Street%20Electric%20Vehicle%20Charging_Puentes.pdf pp. 12

PUBLIC-PRIVATE PARTNERSHIPS

A Public-Private Partnership (PPP) is a long-term contract between two parties, such as the government and a private landowner, that is designed to provide an asset or service to a community.[143] PPPs can be useful for expanding the EV charging network in cities where frequently accessed amenities are not owned by the local government. For example, public EV charging stations should be strategically located in areas where people can park for a few hours, such as parks, churches, grocery stores, movie theatres, or shopping malls. These spaces, including their curbside, may be owned and operated by private landowners. This section of the report assesses potential locations and methods of providing public EV charging through PPPs based on successful policies used in other cities.

PPP Ownership Models

There are two common models of ownership used in EV PPP, including:

1. The infrastructure is built on private land and owned by the city
2. The infrastructure is privately owned but installation is supported by the city.

City-Owned Infrastructure on Private Property

City-owned EV charging infrastructure on private property would be at least partially funded by the property owner but maintained and operated by the City. In this model, the city would financially and administratively support the installation of the infrastructure and get a return on investment through user charging. The City of Vancouver supports this model because it allows them to move the infrastructure, if necessary, as the curbside evolves over time.[144] This model may have lower uptake because private property owners would not receive a return on their investment through user charging. However, the property owner may find other ways to recoup these costs such as minimal price increases to their services or increased sales from drivers shopping while waiting for their vehicle to charge.

Privately-Owned Infrastructure on Private Property (With City Assistance)

The second model of EV charging PPP involves a much more hands-off approach by the local government. In this case, the infrastructure is owned, operated, maintained, and funded by the private property owner while the government provides administrative support or funding. The caveat is that the property owner must provide the EV charging infrastructure as a public asset, rather than as a private charger for their staff or customers. This model of PPP can easily be supported through existing rebates in BC, with the opportunity for additional support (such as financial top-ups) from the local government. Since the infrastructure is privately owned, the city would have little control over the design, location, or operation of the infrastructure. Furthermore, it would be more difficult for the city to ensure that the chargers are being maintained and fixed as needed. Finally, the city would not receive a return on investment through user charging, as they would not have ownership of the equipment.

[143] Wang & Ke. (2018). https://www.researchgate.net/publication/326268789_Public-Private_Partnerships_in_the_Electric_Vehicle_Charging_Infrastructure_in_China_An_Illustrative_Case_Study
[144] Interview with Ian Neville, Senior Sustainability Specialist, City of Vancouver. (2021).

Victoria, Australia implemented this type of PPP by developing a $5 million funding program to support EV charging. In June 2021, The Victorian Government announced the Destination Charging Across Victoria (DCAV) program to build 100 public charging stations across the municipality.[145] The funding is designed for shopping centers, hotels, restaurants, and other tourist destinations or surrounding businesses. These enterprises can sign up for the program and receive partial funding on their installation costs (50% funding will be the most common amount provided).[146] Most of the funding is set to support fast-chargers, which are significantly more expensive to install. This program only provides financial support for EV charging stations and is similar to rebates offered by the BC provincial government. However, Australia's program is solely focused on supporting publicly accessible charging stations at businesses. Applications for this program are still open, so there is currently no information available about interest, uptake, or barriers identified in the process.

Locations and Partnership Opportunities

Cities can partner with a variety of landowners to provide publicly accessible EV charging infrastructure. Providing a stronger public EV charging network supports all EV drivers within and outside of the region and also supports residents living in MURBs who do not have access to at-home charging. While electrical grid capacity and cost are both significant considerations in choosing public charging locations, the nearby amenities also impact charger demand for people who do not live within a 5-minute walk of the station. This section outlines 5 opportunities for partnerships including parks, gas stations, private parking lots or parkades, churches, and stores or restaurants.

Parks

Installing EV charging by public or private parks is a convenient and generally less complicated option for public charging. Most parks in the City of North Vancouver are owned by the municipality and have either a dedicated parking lot or curbside parking. A PPP would be necessary to install EV charging stations at privately owned parks.

Park visitors can spend anywhere from 15 minutes to multiple hours at a park depending on the available amenities, parking restrictions, and green space. Larger parks with fields, bathrooms, pools, sports facilities or trails are better suited for EV charging, as users are more likely to visit for long enough to fully charge their vehicle with level 2 charging infrastructure. However, chargers that are designed to support drivers living in MURBs do not necessarily need to be close to large parks, as drivers are likely to park their vehicle and walk home to wait for charging to finish. Adding EV charging stations to parks also encourages park use and reduces range anxiety for EV users. For these reasons, Tesla and Parks Canada have worked together to supply Tesla and J1772 chargers to 14 Canadian National Parks, with plans for more in the future.[147]

The City of North Vancouver has many parks that could support EV charging infrastructure. Most of these parks include a dedicated parking lot or provide ample curbside parking for at least an hour. Adding EV charging to some of these parks would provide more opportunities for people living in MURBs to charge their vehicles. Some opportunities and challenges of adding EV charging infrastructure to parks are outlined in *Table 16*.

[145] Premier of Victoria. (2021). Getting More Electric Vehicle Chargers Across Victoria. Retrieved from https://www.premier.vic.gov.au/getting-more-electric-vehicle-chargers-across-victoria
[146] Victoria State Government. (2021). Destination Charging Across Victoria Program. Retrieved from https://www.energy.vic.gov.au/grants/destination-charging-across-victoria-grant-program
[147] Clean Technica. (2020). Tesla Donated 350 Charging Stations to Parks Canada. Retrieved from https://cleantechnica.com/2020/08/16/tesla-donated-350-charging-stations-to-parks-canada/

OPPORTUNITIES	CHALLENGES
• Partnering with private landowners may not be necessary, as most parks are city-owned. • The City of North Vancouver could recoup costs through user fees. • Encourages use of local parks and reduces range anxiety for people who want to visit parks. • Convenient option for EV users who already visit parks. • There are 47 parks spread across the city.	• EV charging stations are most suited to large parks that have amenities (bathrooms, food services, etc.). • Some parks may have limited or no electrical service, which would make installation more expensive. • EV charging stations may be in high demand at popular parks, which may decrease the opportunity for MURB residents to charge.

Table 16 - Opportunities and challenges with adding EV charging infrastructure to parks

Gas Stations

As drivers transition from gas-powered vehicles to EVs, the demand for gas stations will slowly decrease. To address this ongoing change, some countries and gas companies have started installing EV charging stations inside of gas stations, turning them into a multi-faceted refueling hub or replacing the gas pumps altogether. While EV charging in gas stations is relatively new, it is becoming much more commonplace in countries such as the United Kingdom, Singapore, Germany, Japan, Canada, and more. Adding EV charging to gas stations is a potentially more cost-effective and efficient option for public charging, especially if gas stations cover the cost of the equipment. Car-users are already experienced with refueling at gas stations, so recharging through level 2 or DCFC spaces would not be a significant change for new EV users.

Gas stations are equipped with an electrical network and are often located in convenient areas for drivers.[148] In the City of North Vancouver, gas stations are typically located next to stores and restaurants along major streets such as Lonsdale Avenue and 3rd Street. Partnering with gas stations may be a cost-effective method of expanding the public charging network in the City.

Examples of government and gas company-led projects that added EV charging to gas stations are outlined in *Table 17*. Each example includes an explanation of the project and how it may relate to the City of North Vancouver. The end of the section includes a summary table outlining the challenges and opportunities to adding EV charging to gas stations in the City of North Vancouver. Please see *Appendix H* for more detailed information about these projects.

COMPANY (COUNTRY)	PROGRAM
BP Chargemaster (United Kingdom)	The company plans to install 400 DCFC stations in BP gas stations across the United Kingdom by the end of 2021.[149] BP states that EVs will only need to stop and charge for 10-12 minutes, which is only slightly longer than the 7-minute average time spent at gas stations by gas-powered vehicle owners. [150]

[148] InsideEVs. (2020). Should Electric Car Chargers Be Installed at Gas Stations? Retrieved from https://insideevs.com/features/457944/electric-vehicle-chargers-gas-stations/
[149] Charged EVs. (2019). BP Chargemaster installs first of 400 150 kW chargers. Retrieved from https://chargedevs.com/newswire/%ef%bb%bfbp-chargemaster-installs-first-of-400-150-kw-chargers/
[150] Charged EVs. (2019). BP Chargemaster installs first of 400 150 kW chargers. Retrieved from https://chargedevs.com/newswire/%ef%bb%bfbp-chargemaster-installs-first-of-400-150-kw-chargers/

Shell & Greenlots (Singapore)	Shell & Greenlots believe that providing EV charging in gas stations will accelerate EV adoption by residents, ridesharing companies, and commercial fleets.[151] DCFC is currently available at 18 gas stations in Singapore.[152] Shell has announced plans to expand charging to half of the 57 gas stations in the country by the end of 2021.[153]
Government (Germany)	Germany is supporting EV adoption by planning to have 1 million charging stations available across the country by 2030.[154] The government is requiring all 14,000 gas stations in the country to provide EV charging stations.[155] This requirement was put in place to reduce range anxiety, which was identified as a key factor dissuading residents from purchasing EVs.[156] There is little information available about the progress of the gas station retrofits; however, Aral AG (a subsidiary of BP in Germany) announced their partnership with Siemens to upgrade gas station grids and install over 100 ultra-fast charging stations in 30 gas stations during the first quarter of 2021.[157] Funded by Germany's 130 billion Euro stimulus programme which includes 2.5 billion Euros to support EV and electric mobility research and development and EV fleets.[158] DCFC was identified as the best option for EV charging in gas stations to maintain a high turnover of vehicles and to make charging as fast as refueling a gas-powered vehicle.[159] Ensuring that EV charging is similar to refueling at gas stations will reduce the number of habits drivers much change when they transition to an EV.
Hyundai Oilbank (South Korea)	Hyundai Oilbank formed an agreement with two other refiners in Korea to install and operate 10 DCFC stations at gas stations and large retail stores by the end of 2020.[160] This group is now planning to install EV chargers at 2,300 Hyundai Oilbank-owned gas stations in South Korea, supporting the EV charging network in the country.[161]
On the Run (Canada)	On the Run is a convenience store chain that is often placed next to gas stations in Canada. In 2021, the company announced a plan to install 25 DCFC stations (100 outlets) between Vancouver Island and Calgary by the end of 2022.[162] On the Run believes that access to shopping, food, and wi-fi will provide a comfortable space for EV users to wait while their vehicle charges.[163]

Table 17 - Case studies of EV charging infrastructure in gas stations

Table 18 outlines some of the opportunities and challenges to supporting the installation of EV charging stations in gas stations.

[151] Greenlots. (2019). Greenlots Installs Shell's First Electric Vehicle Fast-Charger in Singapore. Retrieved from https://greenlots.com/greenlots-installs-shells-first-electric-vehicle-fast-charger-in-singapore/
[152] Shell. (n.d.). Welcome to Shell Recharge. Retrieved from https://www.shell.com.sg/motorists/welcome-to-shell-recharge.html
[153] Channel News Asia. (2021). Shell to Install charging points at half of its petrol stations in Singapore. Retrieved from https://www.channelnewsasia.com/news/videos/shell-to-install-ev-charging-points-at-half-its-petrol-stations-14438948
[154] The Federal Government of Germany. (n.d.) Expanding the charging infrastructure for electric mobility. Retrieved from https://www.bundesregierung.de/breg-en/issues/climate-action/verkehr-1674024
[155] InsideEVs. (2020). Should Electric Car Chargers Be Installed at Gas Stations? Retrieved from https://insideevs.com/features/457944/electric-vehicle-chargers-gas-stations/
[156] Reuters. (2020). Germany will require all petrol stations to provide electric car charging. Retrieved from https://www.reuters.com/article/us-health-coronavirus-germany-autos/germany-will-require-all-petrol-stations-to-provide-electric-car-charging-idUSKBN23B1WU
[157] Siemens. (2021). Siemens and Aral ready gas stations for mobility of the future. Retrieved from https://press.siemens.com/global/en/pressrelease/siemens-and-aral-ready-gas-stations-mobility-future
[158] Germany Federal Ministry of Finance. (2020). Emerging from the crisis with full strength. Retrieved from https://www.bundesfinanzministerium.de/Content/EN/Standardartikel/Topics/Public-Finances/Articles/2020-06-04-fiscal-package.html
[159]Siemens. (2021). Siemens and Aral ready gas stations for mobility of the future. Retrieved from https://press.siemens.com/global/en/pressrelease/siemens-and-aral-ready-gas-stations-mobility-future
[160] The Korea Herald. (2019). Korean oil refiners push into EV charging market. Retrieved from http://www.koreaherald.com/view.php?ud=20190715000565
[161] Charged EVs. (2020). South Korea has fast chargers at 76 gas stations, is planning thousands more. Retrieved from https://chargedevs.com/newswire/south-korea-has-fast-chargers-at-76-gas-stations-is-planning-thousands-more/
[162] Driving. (2021). On the Run convenience stores in B.C. to get EV charging stations. Retrieved from https://driving.ca/auto-news/local-content/on-the-run-convenience-stores-in-b-c-to-get-ev-charging-stations
[163] Driving. (2021). On the Run convenience stores in B.C. to get EV charging stations. Retrieved from https://driving.ca/auto-news/local-content/on-the-run-convenience-stores-in-b-c-to-get-ev-charging-stations

OPPORTUNITIES	CHALLENGES
• Drivers are already familiar with refueling at gas stations, so they may be comfortable charging an EV there as well. • DCFC charging time is comparable with the time it takes to refuel a gas-powered vehicle (as long as the battery is not empty). • Many gas stations are located next to convenience stores, shops, and restaurants. • Gas stations are attached to electrical service. • Gas stations may be interested in providing EV charging so financial support from the City may not be necessary.	• Gas station charging works best with DCFC due to higher turnover rates. DCFC infrastructure is significantly more expensive than level 2 charging infrastructure. • Gas stations must be close to or provide amenities such as food, bathrooms, or shopping to encourage drivers to charge there. • The City of North Vancouver cannot mandate EV charging stations in existing gas stations. It is unlikely that new gas stations will be built in the City.

Table 18 - Opportunities and challenges with adding EV charging to gas stations

Privately-Owned Parking Lots

Parking lots are a good option for public EV charging as they have multiple stalls, are often connected to an electrical service, and allow drivers to park for multiple hours. Parking garages are also often located next to popular amenities and services. For example, In the City of North Vancouver, the Lonsdale Quay is within walking distance of multiple parkades.

Adding EV charging to privately-owned parkades is beneficial for parking lot operators for a number of reasons. First, they can boost revenues by adding user charges to charging stations.[164] In many cases, parking garages charge for EV charger use in addition to parking costs. As EV adoption increases, revenues at parking lots will also increase. Some parking lots, such as the Aspelin Ramm parkade in Oslo, Norway, provide free charging at night for residential vehicles with financial support from the Oslo City Council.[165] Second, parking garages can attract more commuters by providing charging services.[166] Public EV charging is fairly limited in most North American cities, so providing these services will incentivize drivers to park in those lots.

In some cities, parking lot owners are required to provide EV charging infrastructure for residents of the area or for public use.[167] For example, parking lots with fees or time limits in Norway are required to provide EV charging facilities as of July 2018.[168] Other parking operators, such as EasyPark, have implemented EV charging on their own accord to increase profits and lot use. EasyPark currently offers EV charging in 27 lots in Vancouver.[169] Each lot has between 2 and 12 EV charging plugs, with an average of 3 chargers per lot.[170]

Adding EV charging to parkades may be considered by the City of North Vancouver; however, this option will only be attractive to EV users if they are not required to pay for parking in addition to EV charging. The City may consider the opportunity to support free night-time charging in parkades or develop a bylaw that requires private parking lots to provide EV charging. The opportunities and challenges of adding EV charging to parkades are summarized below in *Table 19*.

[164] Charge Point. (n.d.). Parking Operations. Retrieved from https://www.chargepoint.com/en-ca/businesses/parking-operators/
[165] Xuewu Dai, Richard Kotter, Yue Wang, Ridoy Das, Edward Bentley, Mousa Marzband, & Jorden van der Hoogt. (2020). Oslo Operational Report. Retrieved from https://www.seev4-city.eu/wp-content/uploads/2020/09/SEEV4-City-Oslo-Operational-Pilot_Final-Report.pdf pp. 2
[166] Charge Point. (n.d.). Parking Operations. Retrieved from https://www.chargepoint.com/en-ca/businesses/parking-operators/
[167] The Delphi Group. (2019). Own a Parking Lot? See Out Top 5 Electric Vehicle (EV) Considerations. Retrieved from https://delphi.ca/2019/03/top-5-electric-vehicle-ev-considerations/
[168] Zaptec. (2018). Parking areas in Norway will offer EV charging for electric cars from 1 of July. Retrieved from https://zaptec.com/en/parking-areas-in-norway-will-offer-ev-charging-for-electric-cars-from-1-of-july/
[169] EasyPark. (n.d.). Electric Vehicle Charging Stations. Retrieved from https://www.easypark.ca/products-services/electric-vehicle-charging-stations
[170] EasyPark. (n.d.). Electric Vehicle Charging Stations. Retrieved from https://www.easypark.ca/products-services/electric-vehicle-charging-stations

OPPORTUNITIES	CHALLENGES
• Parkades are often in convenient locations with many amenities and services. • Parkades are connected to an electrical network. • Drivers are able to park for multiple hours and charge while they run errands, eat, or visit the surrounding area.	• Parkades may be hesitant to invest in EV charging retrofits. • EV Drivers must pay for both parking and EV charging, which would be a disincentive. Solutions to support MURBs should be as inexpensive as possible.

Table 19 - Opportunities and challenges with adding EV charging to privately owned parking lots

Churches

Churches are another potential location for public EV charging infrastructure in cities and could potentially host overnight charging for local residents, as associated parking lots are often underutilized at night.[171] The City of Saanich identified churches as potential partners to support MURBs with limited charging through their 2020 EV Engagement Strategy. In this summary, the City outlines the possibility of allowing MURB residents to access church or school parking lots after operating hours to charge their EVs.[172] This would provide access to overnight charging for drivers who lack at-home charging options. Similarly, the City of Seattle identified after-hours access to institutional properties as a strategy for reducing barriers to EV charging.[173] However, the City outlines that daytime use of charging infrastructure would increase financial feasibility and could allow for higher charging fees in locations with heavy daytime use.[174] If church parking lots are generally underutilized during the day, there may be an opportunity to lease some parking stalls during the day and more during off-peak hours. This infrastructure could supplement limited at-home charging in MURBs that are within walking distance of a church.

The City of Toronto also identified churches as areas for public EV charging stations but recognized that installing public stations at sites such as schools, churches, and community centers could pose safety and privacy issues.[175] For example, there may be concerns about unidentified residents parking in areas with children nearby. Ultimately, the City of North Vancouver would have to assess and develop mitigation strategies for potential risks before installing charging infrastructure in these areas.

The City of North Vancouver has 14 Churches of variable sizes. Some of these buildings are within a 5-minute walk of MURBs and could be contacted by the City about developing an EV PPP in the Future. *Table 20* summarizes the opportunities and challenges of partnering with a church to provide public EV charging.

[171] Virginia Clean Cities. (2012). Siting Electric Vehicle Charging Stations. Retrieved from http://vacleancities.org/wp-content/uploads/Siting-EV-Charging-Stations-FINAL-11.pdf pp. 17
[172] District of Saanich. (2020). Electric Mobility Strategy – Engagement Summary, October 2020. Retrieved from https://www.saanich.ca/assets/Community/Documents/Planning/sustainability/E-Mobility-Strategy-Final-Engagement-Summary-web.pdf
[173] Seattle Office of Sustainability & Environment. (2014). Removing Barriers to Electric Vehicle Adoption by Increasing Access to Charging Infrastructure. Retrieved from http://www.seattle.gov/Documents/Departments/OSE/FINAL%20REPORT_Removing%20Barriers%20to%20EV%20Adoption_TO%20POST.pdf pp.6
[174] Seattle Office of Sustainability & Environment. (2014). Removing Barriers to Electric Vehicle Adoption by Increasing Access to Charging Infrastructure. Retrieved from http://www.seattle.gov/Documents/Departments/OSE/FINAL%20REPORT_Removing%20Barriers%20to%20EV%20Adoption_TO%20POST.pdf pp.41
[175] City of Toronto. (2017). Preparing Toronto for Electric Vehicles. Retrieved from https://www.toronto.ca/legdocs/mmis/2017/pw/bgrd/backgroundfile-107507.pdf pp.10

OPPORTUNITIES	CHALLENGES
• Large parking lots that are underutilized would provide multiple spaces for EVs to charge. • MURB residents could have the opportunity to charge overnight. • Overnight charging would only require level 1 or level 2 charging infrastructure. • Leasing out spaces overnight for EV charging could be an additional source of revenue for churches. • Charging stations could be connected to the church's electrical panel.	• Potential safety and privacy risks would need to be identified and assessed. • Some residents may be concerned about leaving their vehicle unattended in an empty, unlocked parking lot overnight. The chance of theft may increase if the church is in a low-traffic area. • Churches may be concerned about being held viable for damages to EVs or EV chargers.

Table 20 - Opportunities and challenges with adding EV charging to churches

Stores and Restaurants

Stores and restaurants may be a good option for EV charging PPPs or curbside charging owned by the city. Patrons may spend 1-2 hours sitting and eating at a restaurant or shopping in a mall. This provides ample time to charge an EV with either level 2 or level 3 charging infrastructure. According to a panel webinar hosted by the US Center for Climate and Energy Solutions, adding EV charging to retail and restaurant locations is one of the most profitable ways to improve the public charging network.[176] As discussed in Section 2 of this report, adding an EV charging station in front of a business will increase sales, exposure, and the amount of time drivers spend in the store or restaurant. Atlas Public Policy conducted a study that found that the monetary increase in sales from providing EV charging exceeded the direct income from user charging fees.[177] This model is most successful in densely populated areas with a mix of residential and commercial space, such as the City of North Vancouver. Grants or rebates are important to improve the affordability of charging stations but do not significantly impact profitability.[178]

OPPORTUNITIES	CHALLENGES
• Businesses may be keen to install an EV charging station due to the potential increase in product sales. • The City of North Vancouver can develop a strong case or educational campaign about the benefits of installing EV charging in front of a business. • The City of Vancouver ran a permit program for installing EVs in front of businesses that streamlined the process. There was some interest in this program despite the city not providing additional funding. • Businesses can have on-street and off-street parking. • The city can look into providing low or no-interest loans for the purchase of EV infrastructure.	• Determining the best method of PPP may be difficult. There are a number of options related to who pays and who receives user fees. • The high up-front cost of charging infrastructure is a deterrent for smaller businesses.

Table 21 - Opportunities and challenges with adding EV charging in front of businesses

[176] Penrod, Emma. (2020). Retail co-location may prove key to sustainable funding for charging, panel finds. Retrieved from https://www.utilitydive.com/news/retail-co-location-may-prove-key-to-sustainable-funding-for-ev-charging-pa/578744/
[177] Penrod, Emma. (2020). Retail co-location may prove key to sustainable funding for charging, panel finds. Retrieved from https://www.utilitydive.com/news/retail-co-location-may-prove-key-to-sustainable-funding-for-ev-charging-pa/578744/
[178] Penrod, Emma. (2020). Retail co-location may prove key to sustainable funding for charging, panel finds. Retrieved from https://www.utilitydive.com/news/retail-co-location-may-prove-key-to-sustainable-funding-for-ev-charging-pa/578744/

SECTION 4: RECOMMENDATIONS FOR PRIORITY NEIGHBOURHOODS IN THE CITY OF NORTH VANCOUVER

This section of the report provides recommendations for improving the public charging network, including potential locations for EV chargers in areas that lack access to charging. This section also summarizes the most effective policy solutions identified in *Section 3* of the report that can support the City in the goal to accelerate EV uptake.

MURB RETROFITS AND THE CITY'S ROLE

Installing EV retrofits in MURBs is one of the most effective methods of increasing access to charging and would be an effective solution for all of the priority neighbourhoods identified. At-home charging is preferred by most residents due to convenience and the low cost of energy. While the upfront cost of retrofits may be high, EV-Ready (100%) building retrofits are significantly more cost and energy-efficient per stall compared to standalone retrofits. Furthermore, EV-Ready retrofits are the best way to future-proof existing buildings and help accelerate EV uptake. As such, supporting EV-Ready MURB retrofits should be the first priority in the City of North Vancouver's next EV strategy. Programs may include rebate top-ups, administrative support, and educational campaigns. Any campaigns or programs developed by the City should prioritize EV-Ready retrofits and educate about the challenges of incremental EV retrofits that were outlined in *Section 3* of the report.

ENHANCING THE PUBLIC CHARGING NETWORK

The City of North Vancouver can also improve access to EV charging for people living in MURBs by expanding the public charging network. Providing public charging stations within walking distance of MURBs can supplement the current absence of at-home charging. In this analysis, the pedestrian shed is used to determine priority areas for public EV charging. The pedestrian shed is the average distance that people are willing to walk before opting to drive.[179] For most, this is a 5-minute walk (approximately 400 meters) from start to finish. *Figure 9* shows the distance from MURBs in the City to existing public EV charging stations. The red areas represent buildings that are further than a 5-minute walk from the stations. These buildings were analyzed and categorized to develop priority areas for new public EV charging stations.

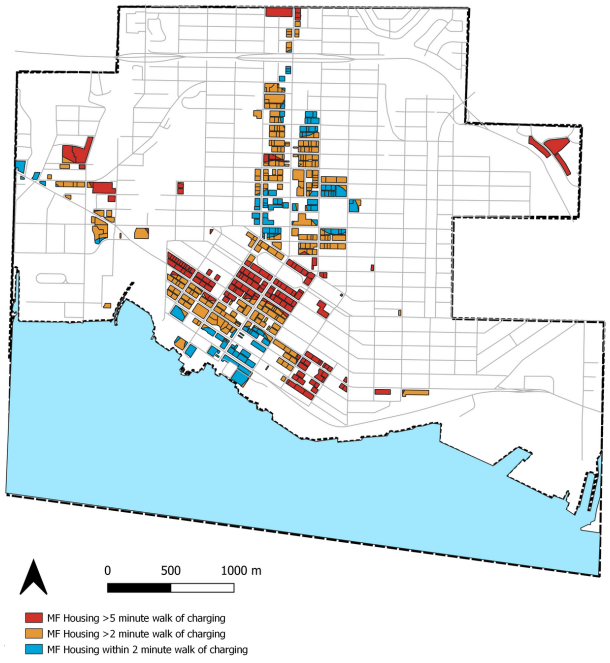

Figure 9 - Walking distance from MURBs to public EV charging stations

[179] Morphocode. (n.d.). The 5-Minute Walk. Retrieved from https://morphocode.com/the-5-minute-walk/#:~:text=The%205%2Dminute%20walk%2C%20also,mile%20or%20about%20400%20meters.

First, the buildings were analyzed on unit density (*see Figure 10*) to determine areas of the City which may require a higher number of public EV charging stations. The buildings were then categorized into 7 areas that are each approximately 1,000 meters wide at the largest point. These neighbourhoods are of different sizes and densities, with Regions B, C, and D having the largest number of MURB units (*See Figure 11*). These locations may require multiple EV charging stations to ensure all dwellings can access charging within a 5-minute walk. Next, each region was analyzed through three lenses, including:

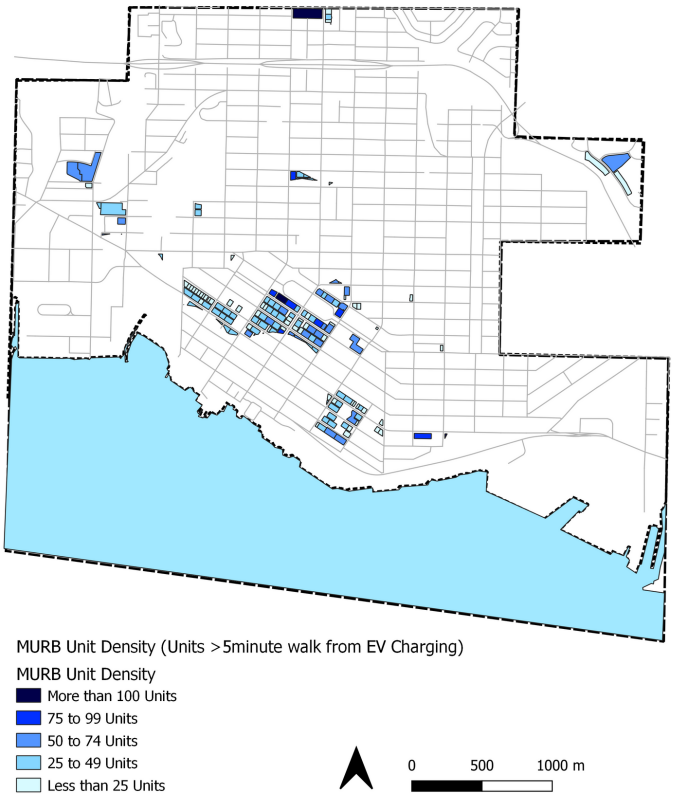

Figure 10 – Unit density of MURBs greater than a 5-minute walk from an EV charging station.

1) applicable policies from *Section 3* of the report,

2) GIS data on parking restrictions, MURB location and density, parking lot locations, City parks, existing charging stations, and the distance of MURBs from charging stations, and

3) Curbside and off-street parking assessments using Google Maps to determine potential locations for EV charging infrastructure.

Locations were identified based on parking restrictions and access, proximity to amenities, and the potential for PPPs. Between 2 and 8 locations were suggested for each study area for a total of 39 locations. Only 12-13 of these locations will be necessary to ensure all residents are able to access an EV charging station within a 5-minute walk of their MURB (*See Figures 12 & 13*). However, additional locations were recommended in case some of the areas cannot support EV charging due to cost, zoning, or other infrastructural problems.

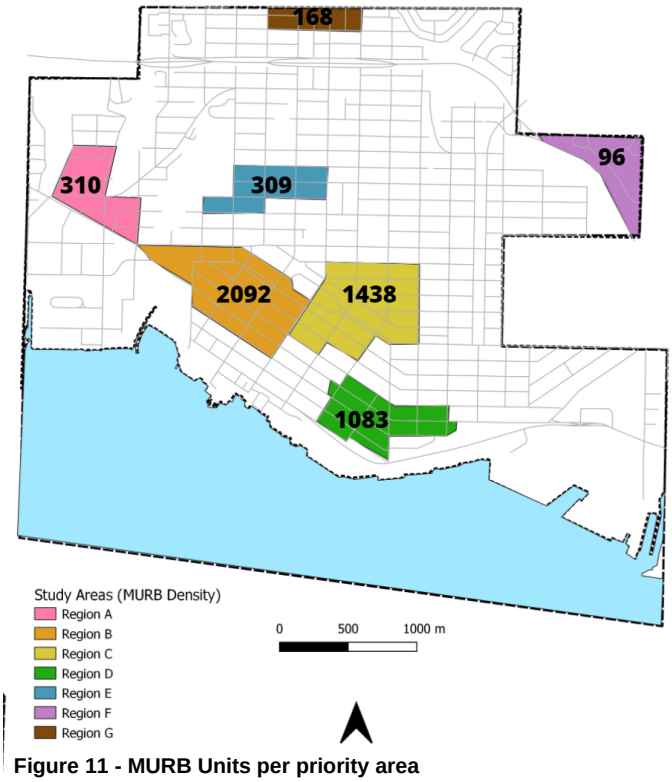

Figure 11 - MURB Units per priority area

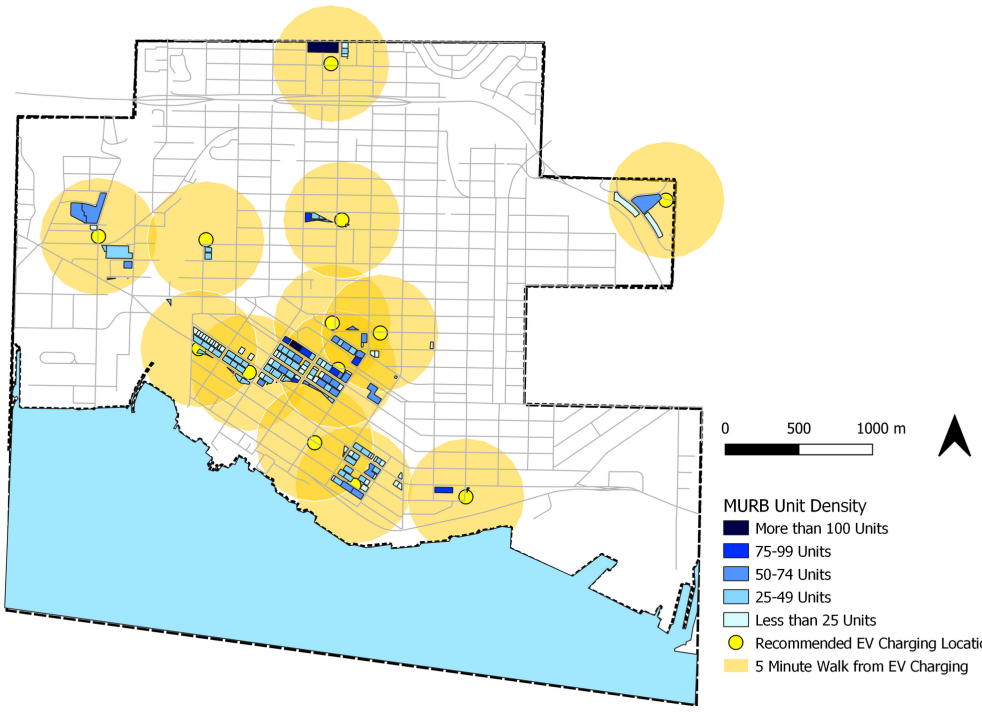

Figure 12 – Original 13 recommended public charging locations

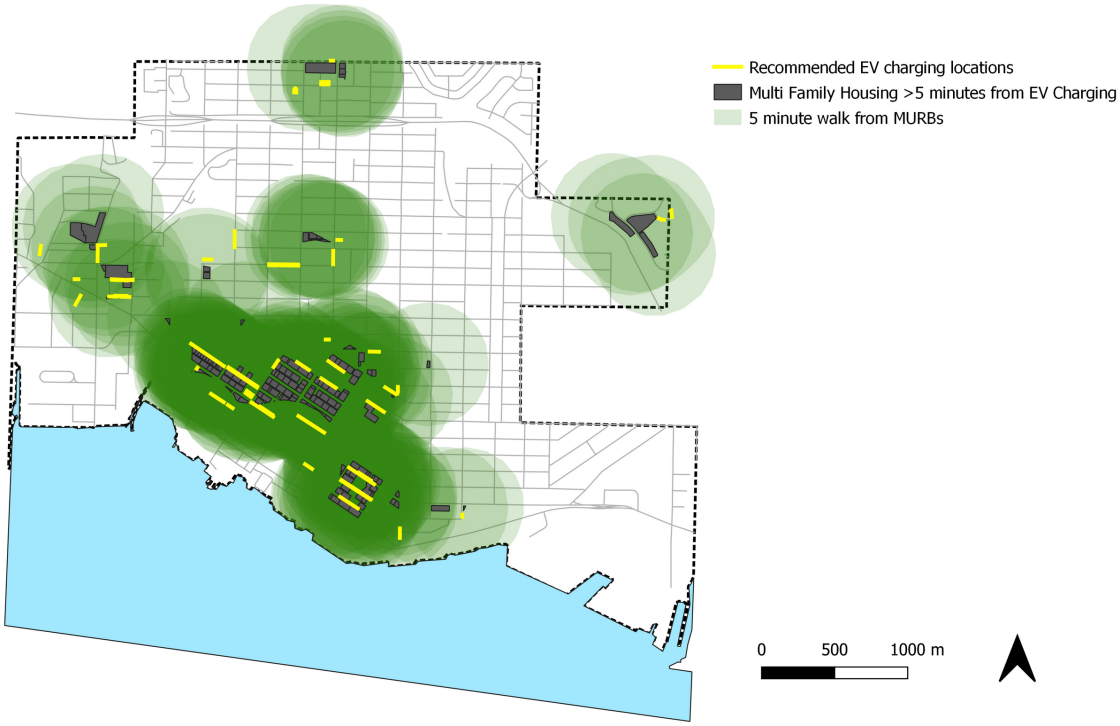

Figure 13 – 39 Proposed locations for public EV charging stations

ASSESSING THE REGIONS

Each region was assessed on parking restrictions, amenities, the opportunity for PPPs, and other challenges and opportunities related to installing EV charging infrastructure. Between 2 and 8 locations were proposed for each study area, depending on the size and feasibility of installing EV chargers. Each location is listed as either ‘on-street’ if it is a curbside charging station or ‘off-street’ if it is located in a parking lot. The curbside analysis applies to on-street charging locations and includes the following considerations:

Must have at least 1 foot of space between the sidewalk and the curb. This typically is either a grass strip or a brick section that is separate from the sidewalk. If the sidewalk is impeded by an EV charging station, it will need to be circumvented to support mobility needs. This process increases the cost of EV charger installation.

1. Streetlight poles must be on the roadside of the sidewalk to be considered for EV charging. If the pole is on the far side, the charging cord will cross over the sidewalk. This would significantly impede mobility.

2. Bike lanes cannot be present on the right side of a designated parking lane. EV charging cords will obstruct the lane when in use.

3. Areas with a large number of parking spaces are preferred to reduce competition for parking.

4. Parking restrictions are analyzed for both types of location and include information such as maximum time limits, open hours, the number of parking stalls, and resident-exempt parking areas. Areas with 2-hour limits or greater are preferred for EV charging. Some areas with 1-hour parking limits were recommended in the analysis under the assumption that hourly restrictions could be increased to support charging. Resident exempt parking areas allow residents of the street to park for up to 72 hours instead of following the posted parking restrictions. This allows residents to charge their vehicle for a longer period of time if necessary.

These public charging recommendations are a short-term solution to improve access to EV charging in MURBs and should be accompanied by other policy changes, financial support, or public charging opportunities in the future. The charging locations recommended in this section are primarily designed to support charging for people living in MURBs, but will also add to the charging pool for other residents and visitors of the City of North Vancouver.

REGION A: EV CHARGING LOCATION RECOMMENDATIONS

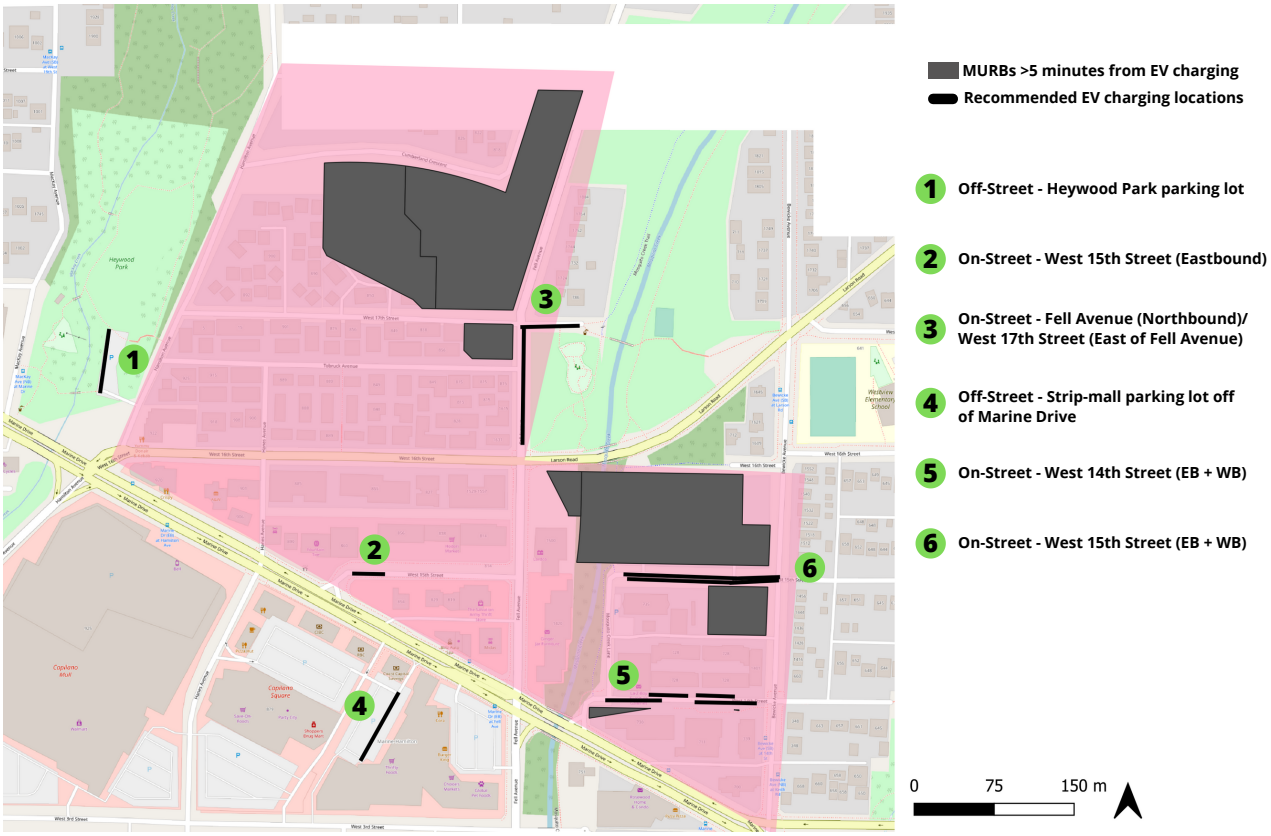

Figure 14 – Region A EV charging location recommendations

Location & Infrastructure Requirements	Parking Restrictions	Opportunities	Challenges	Potential Partners
1 – **Off-street** Heywood Park parking lot. Electrical infrastructure will need to be added to provide EV charging in this area. The charging station could potentially be connected to the electrical grid of the mixed-use building adjacent to the parking lot.	The lot is closed from 11pm to 6am every day. 3-hour parking maximum. 25 parking stalls in the lot.	Access to green space, trails, shopping, restaurants, and Capilano Mall. Many parking spaces available in the lot. There may be an opportunity to allow overnight parking for vehicles actively using the charger. This would require collaboration with the lot owner.	Connecting to the electrical panel in the nearby building may increase installation costs due to the distance from the lot to the building's electrical room. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost. No streetlight poles in the parking lot. Overnight parking is currently prohibited in the lot.	The mixed-use building adjacent to the parking lot. A PPP could be developed with one of the ground-level businesses or with the MURB.
2 – **On-Street** West 15th Street (Eastbound) in the 2-hour parking zone. If the station cannot be connected to a building's electrical grid, new infrastructure will need to be installed. There is an opportunity to connect the EV charger to a nearby streetlight.	2-hour parking limit from 9am to 6pm. There is space on the curb for 4 vehicles.	Wide sidewalk provides ample room for EV charging infrastructure. Streetlights are beside the curb, so there is an opportunity to install streetlight EV charging. Opportunity to partner with a small business or a group of small businesses in the area. This area is less busy compared to the commercial region surrounding Capilano Mall.	There are limited parking spaces in the 2-hour parking area. This is also the only area on the street with streetlights next to the curb. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	The ground-level businesses along West 15th street. There are a number of businesses in the area that could benefit from an EV charging station. This may be an opportunity to support a revenue sharing business model. A partnership with BC Hydro will be necessary to install streetlight EV charging stations.

3 – **On-Street** Fell Avenue by Mosquito Creek Park (Northbound). Electrical infrastructure may need to be added to provide EV charging in this area. There are no nearby commercial buildings or streetlights that can supply power.	No posted parking time limits. Room for 10 vehicles along Fell Avenue and 5 along West 17th Street.	Access to green space, trails, shopping, restaurants, and Capilano Mall. No parking restrictions. Adding EV charging to this location could increase park use.	The sidewalk is directly beside the road, so there is limited room for charging infrastructure. No streetlight poles. There are limited parking spaces around Mosquito Creek Park. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	N/A if the charger is installed on the curb. This would be city-owned infrastructure eon city property.
4 – **Off-Street** Strip-mall parking lot off of Marine Drive. The charging station could potentially be connected to an electrical grid from a nearby business.	Mostly non-restricted parking. Some stalls have limits for specific businesses. Some stalls are designated for specific businesses. 105 parking stalls in the lot.	Opportunity for a revenue sharing business model (multiple businesses invest in an EV charging station). This is a popular area; an EV charging station would benefit all resident and visiting EV owners. There are many parking stalls in the lot. Additional parking is available outside of the lot. Potential access to multiple electrical grids. Good pedestrian and cyclist infrastructure.	Developing a PPP with multiple businesses may be complex. Potential for EV charger congestion, which will reduce access for MURB residents. MURB residents may prefer a neighbourhood charging station over a charging station in a busy area.	One or more of the businesses in the strip-mall. There are a number of businesses in the area that could benefit from an EV charging station. This may be an opportunity to support a revenue sharing business model.
5 – **On-Street** West 14th Street (Eastbound and Westbound). Electrical infrastructure may need to be added to provide EV charging in this area. There is an opportunity to connect an EV charger to a streetlight pole.	West 14th Street is a mix of 1-hour parking, 2-hour parking, and loading zones. The recommended areas for EV charging are only in the 2-hour parking areas. 2-hour parking maximum from 9am to 6pm. Space for 16 cars to park on the Eastbound side of the road and 12 cars to park on the Westbound side.	There is green space between the sidewalk and the curb. This means that an EV charger can be installed without impeding the sidewalk. The westbound side of the street has streetlights that are on the road-side of the sidewalk. There are many MURBs in the area that could benefit from an EV charger.	Limited opportunities for PPPs. Limited on-street parking space. It may be difficult to implement streetlight pole charging stations. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	Potential for a PPP with the La-Z-Boy store. A partnership with BC Hydro will be necessary to install streetlight EV charging stations.
6 – **On-Street** West 15th Street (Eastbound and Westbound). Electrical infrastructure may need to be added to provide EV charging in this area. There is an opportunity to connect an EV charger to a streetlight pole.	No posted parking restrictions. Space for 16 cars to park on the westbound side of the street and 21 cars to park on the eastbound side of the street.	There is green space between the sidewalk and the curb. This means that an EV charger can be installed without impeding the sidewalk. There are streetlights on both sides of the street that are on the road-side of the sidewalk. There are many MURBs in the area that could benefit from an EV charger.	No option for a PPP. It may be difficult to implement streetlight pole charging stations. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	A partnership with BC Hydro will be necessary to install streetlight EV charging stations.

Table 22 - Region A EV charging location justification

REGION B: EV CHARGING LOCATION RECOMMENDATIONS

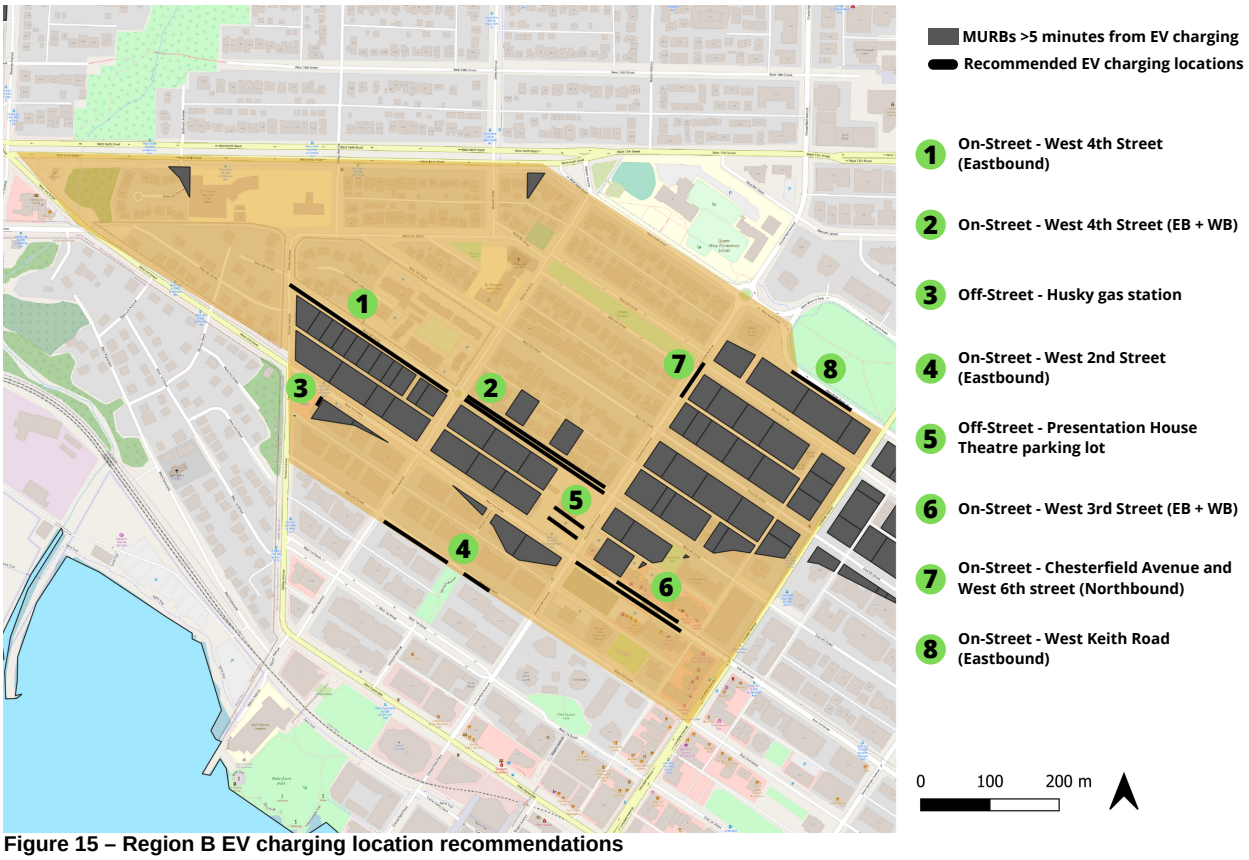

Figure 15 – Region B EV charging location recommendations

Location & Infrastructure Requirements	Parking Restrictions	Opportunities	Challenges	Potential Partners
1 – On-Street West 4th Street (Eastbound). Electrical infrastructure may need to be added to provide EV charging in this area. There is an opportunity to connect an EV charger to a streetlight pole.	No posted parking time limits. No parking 8am to 10am on Wednesdays (street cleaning).	There is green space between the sidewalk and the curb. This means that an EV charger can be installed without impeding the sidewalk. The eastbound side of the street has streetlights that are on the road-side of the sidewalk. There are no parking time limits.	No option for a PPP. It may be difficult to implement streetlight pole charging stations. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	A partnership with BC Hydro will be necessary to install streetlight EV charging stations. No opportunity for a PPP.
2 – On-Street West 4th Street (Eastbound and Westbound). Electrical infrastructure may need to be added to provide EV charging in this area. There is an opportunity to connect an EV charger to a streetlight pole.	Maximum 2-hour parking from 9am to 6pm. Residents exempt from parking restrictions.	Resident exempt parking allows residents to charge for a longer period of time. There is green space between the sidewalk and the curb on both sides of the street. This means that an EV charger can be installed without impeding the sidewalk. The eastbound side of the street has streetlights that are on the road-side of the sidewalk.	No option for a PPP. It may be difficult to implement streetlight pole charging stations. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	A partnership with BC Hydro will be necessary to install streetlight EV charging stations. No opportunity for a PPP.

3 – Off-Street Husky gas station on West 3rd Street and Forbes Avenue. The charging station could be connected to the gas station's electrical grid.	There are 6 parking spaces within the gas station and no posted parking time limits. Parking is designated for users of the gas station.	Adding EV charging to gas stations is becoming more commonplace. The City may not need to provide funding to have this infrastructure installed. Opportunity for a low or no-cost PPP. Electrical infrastructure would be easy to connect to. No parking time limits. Parking spaces are designated for gas station users, so turnover of parking spots would be high. Good pedestrian infrastructure surrounding the gas station, including sidewalks crosswalks, and bus stops.	Limited amenities within walking distance of the gas station. Partnering with the gas station or advocating for them to add EV charging may be a complex and time-consuming process. DCFC is the best option for gas station EV charging to maintain a high turnover rate. This method is significantly more expensive than level 2 charging.	Husky gas station. It may be beneficial to contact Husky Energy and advocate for adding EV charging to their gas stations.
4 – On-Street West 2nd Street at Semisch Park (Eastbound). Electrical infrastructure may need to be added to provide EV charging in this area. There is an opportunity to connect an EV charger to a streetlight pole.	Maximum 2-hour parking from 9am to 6pm. There are 45 parking spaces on the eastbound side of the street.	There is green space between the sidewalk and the curb. This means that an EV charger can be installed without impeding the sidewalk. There are streetlights on the road-side of the sidewalk. Close access to a park. Multiple MURBs on both sides of the street could access this charging station. Many parking spaces available on both sides of the road.	No option for a PPP. It may be difficult to implement streetlight pole charging stations. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	A partnership with BC Hydro will be necessary to install streetlight EV charging stations. No opportunity for a PPP.
5 – Off-Street The Presentation House Theatre parking lot at West 3rd Street and Chesterfield Avenue. The charging station could be connected to the Presentation House Theatre's electrical grid.	There are 38 parking spots that are reserved for users of the Presentation House Theatre. Maximum 3-hour parking limit in the lot.	The site is close to amenities along Lonsdale Avenue and Chesterfield Avenue. The surrounding area has good pedestrian infrastructure, including sidewalks, bus stops, and crosswalks. Electrical infrastructure would be easy to connect to. Opportunity to develop a PPP that could have a low or no-cost to the City. Central destination for multiple MURBs.	The Presentation House Theatre is private property. The City would need to develop a PPP with the building owner to allow for public use of the parking lot. Demand for parking spaces may be high during shows at the Theatre.	The Presentation House Theatre.
6 – On-Street West 3rd Street (eastbound and westbound). The charging station could be connected to a business's electrical grid. There is an opportunity to connect an EV charger to a streetlight pole.	Street parking available on both sides of the street. A few 'no parking' areas and 15-minute parking areas. EV charging is recommended for the 1-hour parking areas only.	Potential for PPPs with one or multiple businesses along West 3rd Street. Access to many electrical grids including multiple businesses and streetlights. There is ample space between the sidewalk and the curb to accommodate an EV charger. The streetlights are on the road-side of the sidewalk. Access to many amenities. Opportunity for a revenue sharing EV business model.	1-hour parking is fairly short for level 2 charging. Level 3 would be more suitable in this location unless the parking maximum could be increased to 2-hours. This is a highly trafficked area. This may result in charger congestion that reduces the ability for MURB residents to charge. Demand for parking spaces is likely high. It may be difficult to implement streetlight pole charging stations.	One or multiple of the businesses along West 3rd Street. A partnership with BC Hydro will be necessary to install streetlight EV charging stations.

7 – On-Street Chesterfield Avenue and West 6th Street (northbound). Electrical infrastructure may need to be added to provide EV charging in this area. There is an opportunity to connect an EV charger to a streetlight pole.	Maximum 2-hour parking from 9am to 6pm.	There is green space between the sidewalk and the curb. This means that an EV charger can be installed without impeding the sidewalk. There are streetlights on the road-side of the sidewalk.	No opportunity for PPPs. It may be difficult to implement streetlight pole charging stations. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	A partnership with BC Hydro will be necessary to install streetlight EV charging stations.
8 – On-Street West Keith Road at Victoria Park (eastbound). Electrical infrastructure may need to be added to provide EV charging in this area.	No posted parking restrictions.	Access to Victoria Park and trails. No posted parking time limits. Close to many MURBs. Strong pedestrian infrastructure including designated walking trails, sidewalks, crosswalks, benches, street trees and bus stops.	No opportunity for PPPs. No space between the sidewalk and the curb. Streetlights are on the far side of the sidewalk from the road. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	No opportunity for a PPP.

Table 23 - Region B EV charging location justification

REGION C: EV CHARGING LOCATION RECOMMENDATIONS

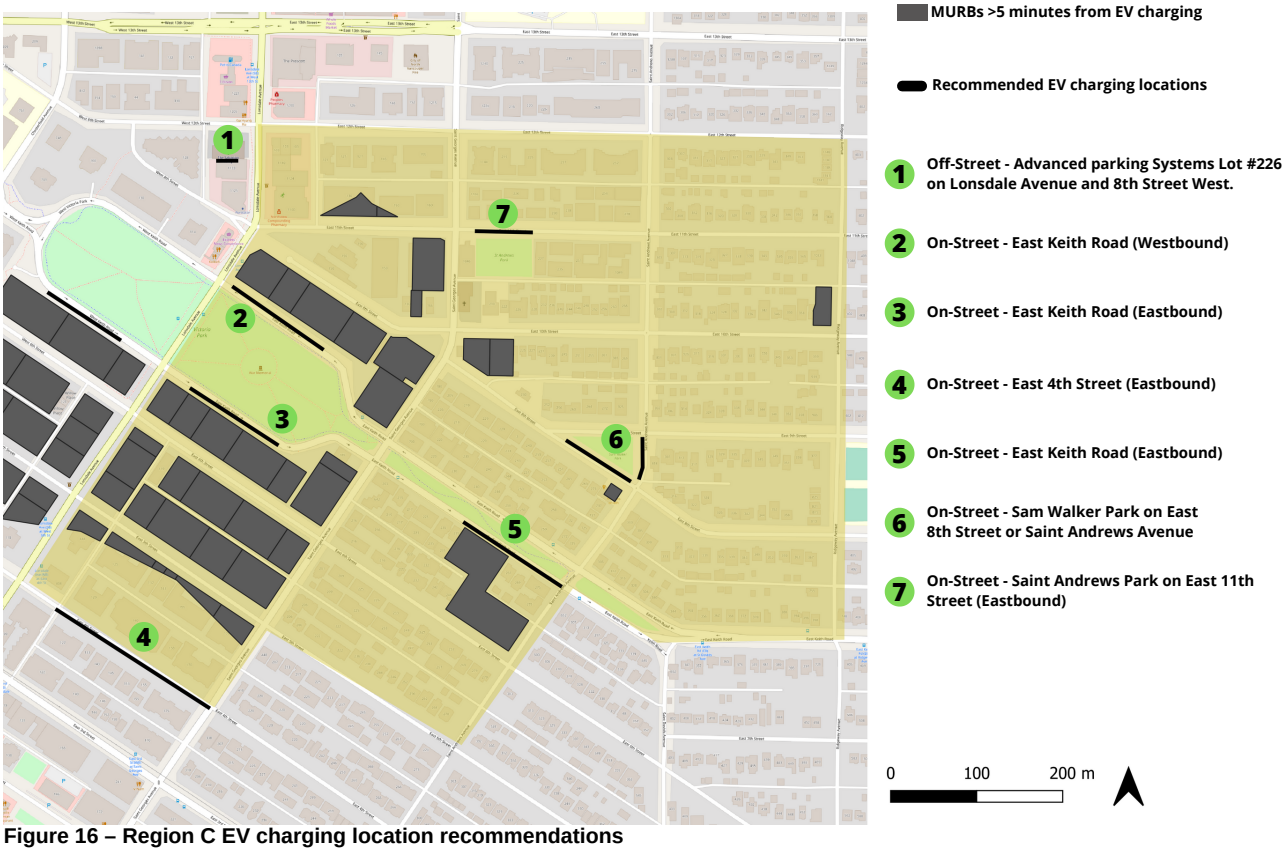

Figure 16 – Region C EV charging location recommendations

Location & Infrastructure Requirements	Parking Restrictions	Opportunities	Challenges	Potential Partners
1 - Off-Street Advanced Parking Systems Lot #226 on Lonsdale Avenue and 8th Street West. This is an underground pay parkade operated by Advanced Parking Systems Ltd. The charging station could be connected to a business's electrical grid.	The parking lot has 136 parking stalls. The lot is open Monday to Friday from 6:00am to 5:30pm. Parking costs $2.00 for 30 minutes and $9.00 for a day pass.[180]	There are many amenities available along Lonsdale Avenue, including Victoria Park, restaurants, shopping, and City Hall. The parking lot is covered and is connected to the building's electrical grid. There may be an opportunity to allow overnight EV charging.	This is a pay parking lot. EV users would need to pay $9.00 for parking on top of the charging costs. The City would need to implement a policy or partner with the lot to ensure MURBs do not have to pay additional money to charge. Otherwise, this location would not be suitable to supplement MURB charging. This lot has limited open hours during the week and is not open during the weekend. This impedes the ability for people to charge after work or during the weekend.	Advanced Parking Systems.
2 – On-Street East Keith Road (westbound) (East of Lonsdale Avenue). Electrical infrastructure may need to be added to provide EV charging in this area.	No posted parking restrictions.	There is green space between the sidewalk and the curb. This means that an EV charger can be installed without impeding the sidewalk. There are streetlights on the road-side of the sidewalk. Access to Victoria Park and trails. No posted parking time limits. Close to many MURBs. Strong pedestrian infrastructure including designated walking trails, sidewalks, crosswalks, benches, street trees and bus stops.	No opportunity for PPPs. It may be difficult to implement streetlight pole charging stations. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost. There may be competition for curbside parking.	A partnership with BC Hydro will be necessary to install streetlight EV charging stations.
3 – On-street East Keith Road (eastbound) (East of Lonsdale Avenue). Electrical infrastructure may need to be added to provide EV charging in this area.	There are no posted parking restrictions.	There is green space between the sidewalk and the curb in some areas. This means that an EV charger can be installed without impeding the sidewalk. There are streetlights that are on the road-side of the sidewalk. Access to Victoria Park and trails. No posted parking time limits. Close to many MURBs. Strong pedestrian infrastructure including designated walking trails, sidewalks, crosswalks, benches, street trees and bus stops.	There may be competition for curbside parking. No opportunity for PPPs. It may be difficult to implement streetlight pole charging stations. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	A partnership with BC Hydro will be necessary to install streetlight EV charging stations.
4 – On-Street East 4th Street (eastbound) (East of Lonsdale Avenue). Electrical infrastructure may need to be added to provide EV charging in this area. There is an opportunity to connect to the electrical grid of the 4th Street Gospel Church.	No posted parking restrictions.	There is green space between the sidewalk and the curb. This means that an EV charger can be installed without impeding the sidewalk. There are streetlights that are on the road-side of the sidewalk. Opportunity to partner with the 4th Street Gospel Church. Many MURBs on both sides of the street.	It may be difficult to implement streetlight pole charging stations. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	The 4th Street Gospel Church.

[180] Parkopedia. (n.d.). Advanced Parking Systems Lot #226. Retrieved from https://en.parkopedia.ca/parking/parkade/advanced_parking_systems_lot_226/v7m/north_vancouver/?arriving=202107051300&leaving=202107051500

5 – On-Street East Keith Road (eastbound) (East of St. Georges Avenue). Electrical infrastructure may need to be added to provide EV charging in this area.	No posted parking restrictions.	There is greenspace between the sidewalk and the curb. Streetlight poles are on the road-side of the sidewalk Access to pedestrian and cyclist trails and connection to Victoria Park. No parking time limits. Many parking spaces available along the street.	Streetlight poles may not be suitable for EV charging infrastructure. It may be difficult to implement streetlight pole charging stations. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost. Fewer MURBs on this section of the street.	A partnership with BC Hydro will be necessary to install streetlight EV charging stations.
6 – On-Street Sam Walker Park on East 8th Street or St. Andrews Avenue. Electrical infrastructure may need to be added to provide EV charging in this area.	No posted parking restrictions.	There is green space between the sidewalk and the curb. Powerline poles are on the street-side of the sidewalks. Close proximity to many MURBs. Access to Sam Walker Park and seating areas.	There may be competition for curbside parking. No opportunity for PPPs. It may be difficult to implement streetlight pole charging stations. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	A partnership with BC Hydro will be necessary to install streetlight EV charging stations.
7 – On-street Street parking beside St. Andrews Park located on East 11th Street. The Park is open to the public from dawn to dusk every day. Electrical infrastructure may need to be added to provide EV charging in this area. There is an opportunity to use the electrical grid of the St. Andrews United Church or Alcuin College.	Maximum 2-hour parking between 9am and 6pm. There are approximately 16 parking spaces along East 11th Street within the 9am to 6pm parking area. Further east, there are non-regulated parking spaces in front of single-family residential homes in the area.	St. Andrews Park is a popular park in the City of North Vancouver for families with young children. It would be beneficial for families who use EVs if a charging station was installed there.[181] The Park has a temporary bathroom (porta-potty). There are many amenities close to St. Andrews Park. There is good pedestrian infrastructure around the park including sidewalks, crosswalks, and bus stops.	Parking is very limited close to St. Andrews Park. No space between the sidewalk and the curb. Streetlight poles are on the far side of the sidewalk from the road. It may be necessary to install new electrical infrastructure to support an EV charging station.	St. Andrews United Church or Alcuin College.

Table 24 - Region C EV charging location justification

[181] City of North Vancouver. (2014). St. Andrews Park Study – Open House. Retrieved from https://www.cnv.org/-/media/city-of-north-vancouver/documents/parks-and-environment/parks/st-andrews-park-study---open-house---display-boards.pdf

REGION D: EV CHARGING LOCATION RECOMMENDATIONS

Figure 17 - Region D EV charging location justification

Location & Infrastructure Requirements	Parking Restrictions	Opportunities	Challenges	Potential Partners
1 – On-Street Visitor parking in the lane North of Derek Inman Park. (Behind the North Shore Neighbourhood House). There is an opportunity to partner with the Northshore Neighbourhood House.	Maximum 2-hour parking in the visitor lot.	A large number of amenities can be accessed within a 5-minute walk of the proposed station Good pedestrian infrastructure including sidewalks, crosswalks, and bus stops. The North Shore Neighbourhood House already has a partnership with the City of North Vancouver. Developing a PPP for EV charging may be easier due to this existing relationship. Access to streetlight poles and powerline poles.	There is limited on-street and off-street parking in this area. It may be difficult to implement streetlight pole charging stations due to the size and placement of parking stalls.	Northshore Neighbourhood House A partnership with BC Hydro will be necessary to install streetlight EV charging stations.
2 – On-Street East 3rd Street (Eastbound and Westbound). Electrical infrastructure may need to be added to provide EV charging in this area.	No posted parking time limits. There are a few no stopping zones.	There is green space between the sidewalk and the curb in some areas. There are streetlights that are on the road-side of the sidewalk in some areas (More on the westbound side). No posted parking time limits. Close to many MURBs. Access to Emerald Park. Strong pedestrian infrastructure including designated walking trails, sidewalks, crosswalks, benches, and bus stops.	No opportunity for PPPs. It may be difficult to implement streetlight pole charging stations. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	A partnership with BC Hydro will be necessary to install streetlight EV charging stations.

3 – On-Street East 2nd Street (eastbound and westbound) Electrical infrastructure may need to be added to provide EV charging in this area.	No posted parking time limits. There are a few no stopping zones.	There is green space between the sidewalk and the curb in some areas. There are streetlights on the road-side of the sidewalk in some areas. No posted parking time limits. Close to many MURBs. Strong pedestrian infrastructure including designated walking trails, sidewalks, crosswalks, benches, and bus stops. Access to Emerald Park and Hamersley Park.	No opportunity for PPPs. It may be difficult to implement streetlight pole charging stations. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	A partnership with BC Hydro will be necessary to install streetlight EV charging stations.
4 – On-Street Street parking south of Hamersley Park on East 1st Street (westbound). Electrical infrastructure may need to be added to provide EV charging in this area.	There is a small area beside Hamersley Park that has a 2-hour parking limit between 9am and 6pm. This portion of the street has room for approximately 4 cars. The remainder of the street does not have any parking restrictions.	There is a large amount of parking available on East 1st Street. Access to Hamersley Park and trails. Very few parking restrictions along East 1st Street. There is green space between the sidewalk and the curb. There are streetlights (connected to powerline poles) that are on the road-side of the sidewalk.	The Park does not have a dedicated electrical grid. This will make installation more expensive. No opportunity for PPPs. It may be difficult to implement streetlight pole charging stations.	A partnership with BC Hydro will be necessary to install streetlight EV charging stations.
5 – On-Street St. David's Avenue (southbound) Electrical infrastructure may need to be added to provide EV charging in this area.	No posted parking time limits.	No posted parking restrictions. There is green space between the sidewalk and the curb. There are streetlights (connected to powerline poles) that are on the road-side of the sidewalk. Access to Moodyville Dog Park and the Spirit Trail.	No opportunity for PPP's It may be difficult to implement streetlight pole charging stations. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	A partnership with BC Hydro will be necessary to install streetlight EV charging stations.
6 – On-Street Street Parking at Moodyville Park on East 2nd Street and Moody Avenue. Electrical infrastructure may need to be added to provide EV charging in this area.	The dedicated parking strip on Moody Avenue does not have any parking restrictions. However, there are only 5 parking spaces available in this area. There is additional 1 hour street parking along 2nd Street East. This restriction runs from 6am to 6pm, Monday to Friday.	Access to greenspace, dedicated trails, and sports courts. Close to many MURBs No posted parking restrictions in recommended area.	The dedicated parking area is not close to an electrical panel. This will make installation more expensive. No nearby streetlight poles. Dedicated parking for Moodyville Park is extremely limited.	No opportunity for a PPP.

Table 25 - Region D EV charging location justification

REGION E: EV CHARGING LOCATION RECOMMENDATIONS

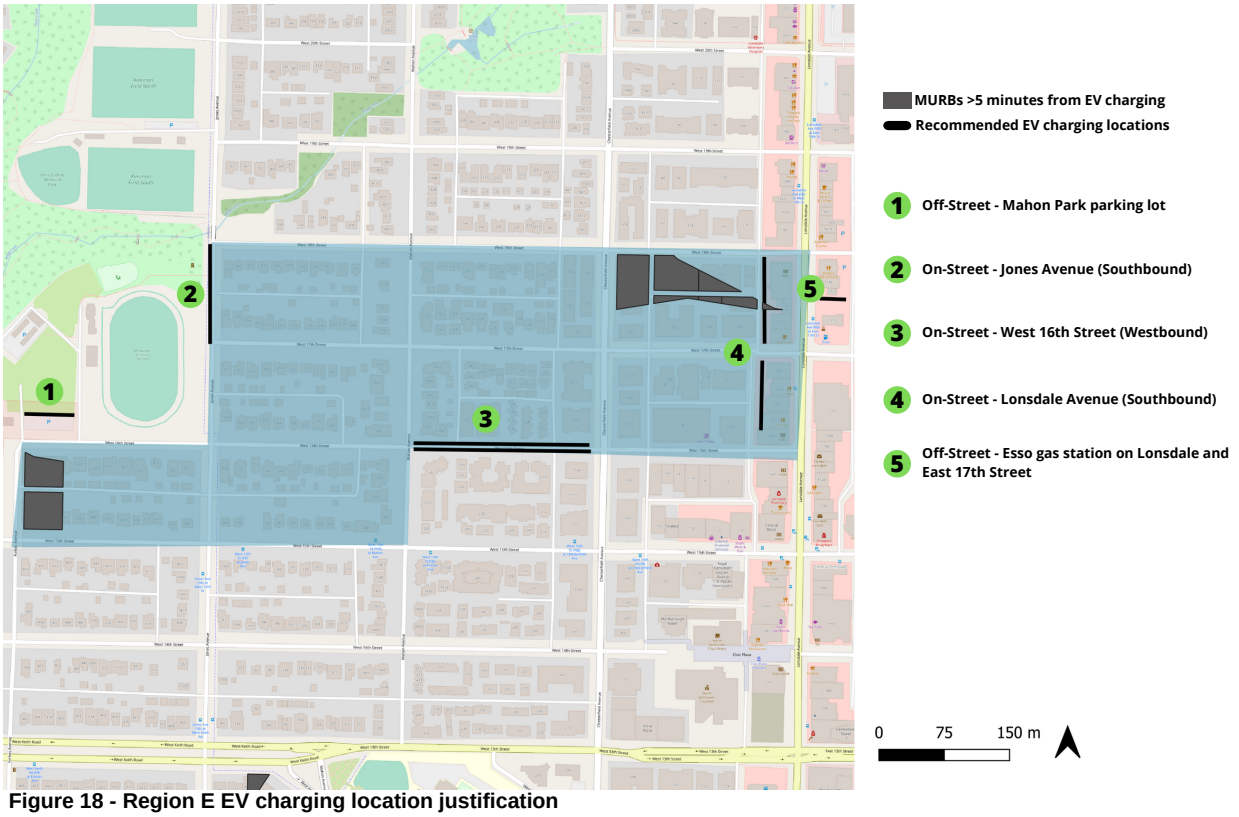

Figure 18 - Region E EV charging location justification

Location & Infrastructure Requirements	Parking Restrictions	Opportunities	Challenges	Potential Partners
1 – Off-Street The parking lot at Mahon Park located on Forbes Avenue and West 16th Street. There is an opportunity to use power from the Mahon Park Childcare Centre grid.	The parking lot is closed from 11pm to 6am everyday. There are 42 parking spots available in the lot.	Mahon Park has many amenities and greenspaces. Excellent pedestrian and Cyclist infrastructure. Ample space for parking in and around the park. Opportunity to partner with the Mahon Park Childcare Centre.	It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	Mahon Park Childcare Centre.
2 – On-Street Jones Avenue (southbound) between West 17th Street and West 18th Street. Electrical infrastructure may need to be added to provide EV charging in this area.	No posted parking restrictions.	There is a large amount of parking available along Jones Avenue. Access to Mahon Park and surrounding amenities. No posted parking restrictions. There is green space between the sidewalk and the curb.	Streetlight poles are on the far side of the sidewalk from the street. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	Not applicable
3 – On-Street West 16th Street (westbound) Electrical infrastructure may need to be added to provide EV charging in this area.	Maximum parking for 2-hours between 9am and 6pm. Residents with valid parking passes are exempt from posted parking restrictions and may park for up to 72 hours.	There is green space between the sidewalk and the curb. Powerline poles are on the road-side of the sidewalk. Residents are exempt from parking restrictions and can therefore charge for longer periods of time. Lots of parking spaces available on both sides of the street.	It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost. No streetlight poles.	A partnership with BC Hydro will be necessary to install EV charging stations on utility poles.

4 – On-Street Lonsdale Avenue (southbound) between West 16th Street and West 17th Street. There is an opportunity to use power from one the businesses along this section of Lonsdale Avenue or to connect to streetlight poles.	Maximum 1 hour parking from 9am to 6pm.	Opportunity to partner with one or more businesses. There is room between the sidewalk and the curb. There are many businesses along Lonsdale. Streetlight poles are beside the road.	1-hour parking is fairly short for level 2 charging. Level 3 would be more suitable in this location unless the parking maximum could be increased to 2-hours. Lonsdale is a heavily trafficked area in the City. This charging station thus may become congested. Parking is limited along Lonsdale Avenue.	One or more of the businesses in this section of the street. There may also be an opportunity to install an EV charging station in the lane to the West of Lonsdale behind these businesses. These areas are staff-only parking, but an agreement could be made to support a public EV-charging station.
5 – Off-Street The Esso gas station on Lonsdale Avenue and West 17th Street. There is an opportunity to use power from the Esso gas station.	Parking spaces are designated for gas station users to ensure fast turnover. There are no posted time limits for parking. The gas station has 5 parking spaces next to the car wash and 3 parking spaces next to the gas pumps.	Adding EV charging to gas stations is becoming more commonplace. The city may not need to provide a lot or any funding to have this infrastructure installed. The gas station is connected to an electrical grid, so installation will be less expensive. Close proximity so surrounding businesses and amenities. Strong pedestrian infrastructure including sidewalks, crosswalks, and bus stops.	It may be difficult to develop a partnership with the gas station. There are few parking spaces available at the gas station.	**Off-Street - Parking lot at Cedarview Lodge** The Esso gas station. It may be beneficial to contact Esso Canada and advocate for adding EV charging to their gas stations.

Table 26 - Region E EV charging location justification

REGION F: EV CHARGING LOCATION RECOMMENDATIONS

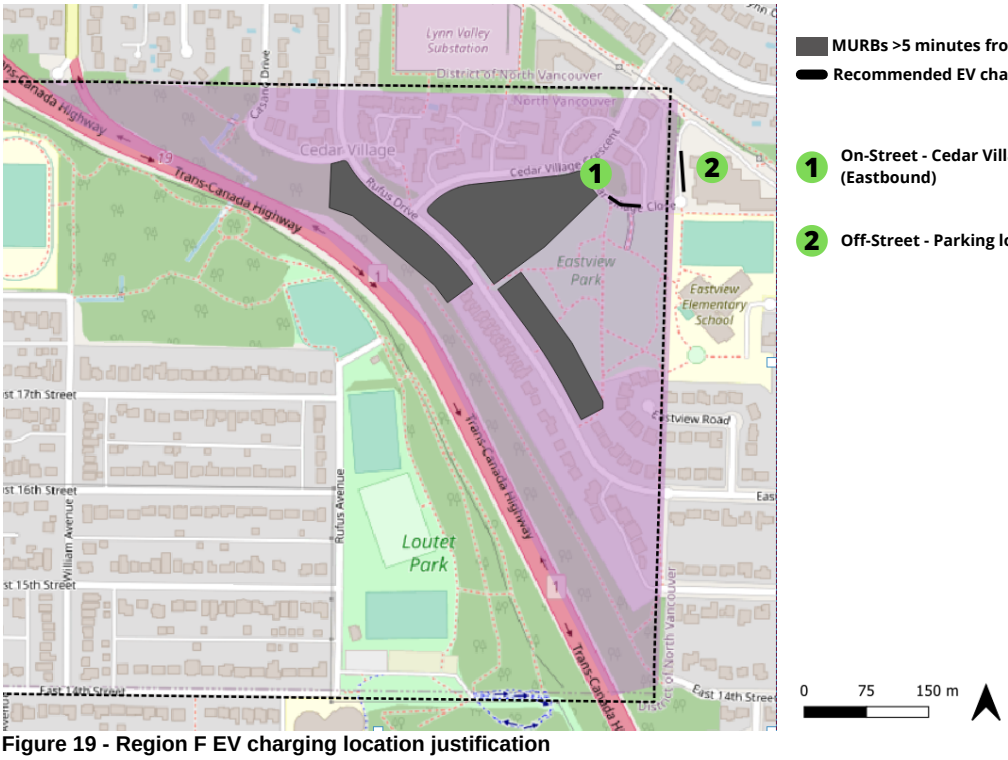

Figure 19 - Region F EV charging location justification

Location & Infrastructure Requirements	Parking Restrictions	Opportunities	Challenges	Potential Partners
1 – Off-Street The parking lot at Mahon Park located on Forbes Avenue and West 16th Street. There is an opportunity to use power from the Mahon Park Childcare Centre grid.	The parking lot is closed from 11pm to 6am everyday. There are 42 parking spots available in the lot.	Mahon Park has many amenities and greenspaces. Excellent pedestrian and Cyclist infrastructure. Ample space for parking in and around the park. Opportunity to partner with the Mahon Park Childcare Centre.	It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	Mahon Park Childcare Centre.
2 – On-Street Jones Avenue (southbound) between West 17th Street and West 18th Street. Electrical infrastructure may need to be added to provide EV charging in this area.	No posted parking restrictions.	There is a large amount of parking available along Jones Avenue. Access to Mahon Park and surrounding amenities. No posted parking restrictions. There is green space between the sidewalk and the curb.	Streetlight poles are on the far side of the sidewalk from the street. It may be necessary to install new electrical infrastructure to support an EV charging station. This will significantly increase the installation cost.	Not applicable

Table 27 - Region F EV charging location justification

REGION G: EV CHARGING LOCATION RECOMMENDATIONS

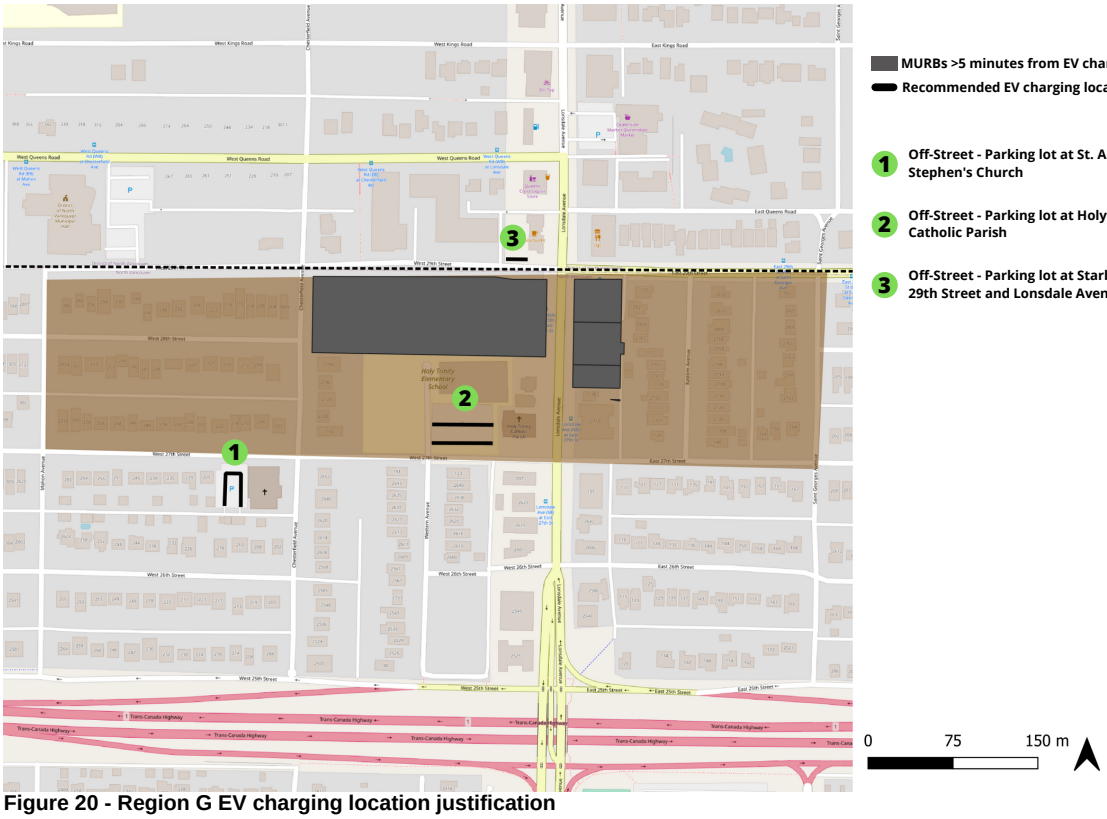

Figure 20 - Region G EV charging location justification

Location & Infrastructure Requirements	Parking Restrictions	Opportunities	Challenges	Potential Partners
1 – Off-Street Parking lot at St. Andrew's and St. Stephen's Church on Chesterfield Avenue and West 27th Street. There is an opportunity to connect to the church's electrical grid.	No posted parking restrictions. This is a private parking lot for the church. The City will need to collaborate with the building owners to allow public access. There are 35 parking stalls in the lot.	Opportunity to partner with the church and connect to their electrical grid. Church parking lots are typically under utilized (except on Sundays and during special events). There may be an opportunity to allow EV charging overnight, which would only require level 1 charging infrastructure.	Developing a PPP may be complex. This location is slightly further away from MURBs compared to other suggested locations.	St. Andrew's and St. Stephen's Church.
2 – Off-Street The Parking lot at Holy Trinity Catholic Parish located on Lonsdale Avenue and West 27th Street. There is an opportunity to connect to the church's electrical grid.	There are a total of 55 parking spaces in the Holy Trinity Catholic Parish parking lot. Some of the parking spaces are reserved for school faculty Monday to Friday from 8:15am to 3:15pm. There are no posted restrictions on the remainder of the parking spaces.	Many parking stalls in the lot. Good pedestrian infrastructure including sidewalks, crosswalks, and bus stops Close to MURBs in the area. Access to commercial amenities along Lonsdale Avenue. The proposed EV charging station could be connected to the Catholic Parish's electrical grid. There is an opportunity to develop a PPP.	The parking lot may be busy during church services and during school pick-up and drop-off times. Developing a PPP may be complex.	Holy Trinity Catholic Parish.
3 – Off-Street Parking lot at Starbucks on West 29th Street and Lonsdale Avenue. There is an opportunity to connect to the Starbucks electrical grid.	Maximum 2-hour parking. There are 12 parking spaces in the lot.	There is an opportunity to partner with the Starbucks.	This location is outside of the border of the City of North Vancouver. The City would need to collaborate with the District of North Vancouver to install this charger. Limited parking spaces in this lot.	District of North Vancouver. The Starbucks.

Table 28 - Region G EV charging location justification

RECOMMENDED POLICY SOLUTIONS

The City of North Vancouver must take steps to improve the public EV charging network and to support at-home charging for people living in MURBs. This report analyzed a number of different support methods including financial, educational, administrative, and policy advocacy that can be spearheaded or reinforced by the City. A mix of the best practices identified in *Section 3* of the report will be required to accelerate the rate of EV adoption. The recommended actions for the City of North Vancouver have been summarized in *Table 29*.

The highest priority actions are highlighted in green and medium-priority actions are highlighted in yellow. These actions were prioritized based on their potential impact to increase EV uptake in the City. Generally, supporting MURB EV charging retrofits was identified as one of the most effective methods of increasing EV uptake. Improving the public charging network is necessary to provide access to charging for people who cannot install chargers in their place of residence. Finally, informing residents, landlords, and business owners about the costs and benefits of EV charging infrastructure may improve the private and public EV charging networks in the City of North Vancouver.

CATEGORY	ACTIONS FOR THE CITY OF NORTH VANCOUVER
MURB Retrofits	Explore opportunities to finance EV charging rebate top-ups. Give priority to buildings that are planning EV-Ready or large-scale retrofits. Assess EV uptake in rented MURBs and look into providing rebate top-ups specifically for rental units if needed.
MURB Retrofits	Explore opportunities to provide low or no-interest loans for the purchase and installation of EV charging infrastructure. Collaborating with Vancity is one option for providing this type of financial support.
Education	Support EV-Ready retrofits in MURBs or standalone EV chargers in shared parking spaces by developing an education and awareness campaign. This campaign can be shared through multiple channels such as social media, newspapers, local billboards, and the City's website. Use guidance materials developed by BC Hydro, Plug-In BC, and Emotive.
Education	Explore funding opportunities for new education programs, such as Emotive's COIP.
Education	Develop an education campaign to support strata councils and residents when Right to Charge legislation is implemented in BC. This campaign can outline the benefits of EV-Ready retrofits over standalone retrofits.
Policy	Through the development application process, encourage large developments to provide publicly accessible EV charging stations. This would be in addition to the 100% EV-Ready parking spaces in residential buildings and 45% EV ready parking spaces in non-residential buildings already mandated by the City.
Public Charging	Analyze the recommended public charging station locations in this report and begin reaching out to private property owners to gauge their interest in a PPP. Once locations are identified, install public charging stations to ensure all MURBs are within a 5-minute walk of EV charging. Prioritize high-density areas and locations that are central to multiple MURBs. This can be accomplished through a mix of City-owned on-street and off-street charging options or through the development of PPPs.
Public Charging	Investigate the opportunity to install EV chargers on streetlight poles. Identify areas in the City with appropriate infrastructure and then communicate and collaborate with BC Hydro to develop a pilot project. Follow the City of Vancouver's streetlight pole pilot project once it is developed.

Public Charging	Develop an education and awareness campaign directed towards local businesses. Outline the benefits of providing publicly accessible EV charging and types of shared revenue business models. Provide contact information or an application link for businesses to explore a PPP opportunity with the City. Reach out to gas companies with stations in the City and inquire about their EV charging plans. Advocate to have EV charging stations installed in the City of North Vancouver.
Public Charging	Collaborate with the District of North Vancouver to identify areas for public EV charging stations along the border of the City of North Vancouver that would benefit both jurisdictions. Areas of the City of North Vancouver such as Region F in the analysis are disconnected from EV charging stations due to the Upper Levels Highway and have limited areas for EV charging stations due to the proximity to the City's border. Since an EV charging station would benefit residents from both the City and the District of North Vancouver, collaborating on a location could be beneficial.
Public Charging	Develop a program to improve public EV charging signage or provide an opportunity to combine public art with EV charging stations.

Table 29 - Recommended actions to increase EV charging in the City of North Vancouver

Implementing some or all of the best practices identified above will help accelerate the rate of EV adoption in the City of North Vancouver and support the City in achieving its goal of producing net-zero emissions by 2050. It will be necessary for the City to invest in charging infrastructure now so that public charging stations can be profitable in the future. As EV uptake increases, the City will likely see a return on investment for City-owned EV charging infrastructure. The City of North Vancouver can accelerate the adoption of EVs through a number of initiatives including financial and administrative support, education, advocating for EV policies, and supporting the public charging network. Education and awareness are key to improving EV uptake and supporting residents to push for EV retrofits in their building. All new programs and initiatives implemented by the City of North Vancouver or other governments should be communicated with residents as soon as possible and through multiple media channels. EV-Ready and bulk retrofits in MURBs should be prioritized to future-proof the City and allow more residents to comfortably own an EV in the future.

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APPENDIX

APPENDIX A: THE CITY OF NORTH VANCOUVER'S 2018 EV STRATEGY UPDATE + BARRIERS TO EV CHARGING

1. Charging Infrastructure: New Construction

In early 2019, the North Vancouver City Council adopted a zoning bylaw amendment which requires 100% of new residential parking stalls to be equipped with an energized outlet.[182] This policy allows residents to charge their EV through level 1 or level 2 charging infrastructure and has led to 500 EV-ready parking spots since its adoption in February 2019.[183] These EV-ready parking spaces were spread across single-family, duplex, coach home, and multi-family buildings. The City is also exploring EV-ready requirements for new non-residential buildings including workplaces and other destinations where residents are likely to park for a few hours.[184]

This requirement has not been implemented in many MURBs due to its recent implementation. As existing MURBs and single-family buildings age and are eventually replaced, this bylaw will increase access to EV charging; however, there is a need for shorter-term solutions such as retrofits in existing buildings, public charging, and workplace charging.

2. Charging Infrastructure: Existing Buildings

The City has supported EV retrofits in existing multi-family buildings by promoting charging station rebates offered by the provincial government. However, there are significant barriers that prevent residents living in MURBs from installing EV charging in their building including costs, lack of support from strata corporations, misinformation, and the layout and electrical infrastructure in the building. Due to these reasons, North Vancouver does not have legislation that requires EV charging retrofits to be added to existing buildings. However, the City is exploring the opportunity to provide rebate top-ups to reduce the individual cost of building retrofits.[185]

Identifying opportunities to increase EV charging in existing MURBs is the bulk of this report. This category in the 2018 EV Strategy faced the largest number of barriers and will need to be addressed in the City's updated strategy.

[182] City of North Vancouver. (2020). AGENDA FOR THE REGULAR MEETING OF COUNCIL, HELD ELECTRONICALLY FROM CITY HALL, 141 WEST 14TH STREET, NORTH VANCOUVER, BC, ON MONDAY, DECEMBER 14, 2020 AT 5:30 PM. Retrieved from https://www.cnv.org/-/media/City-of-North-Vancouver/Documents/Council-Meeting-Agenda/2020/2020-12-14-Regular-Agenda-Package-for-December-14-2020.ashx pp.157
[183] City of North Vancouver. (2020). AGENDA FOR THE REGULAR MEETING OF COUNCIL, HELD ELECTRONICALLY FROM CITY HALL, 141 WEST 14TH STREET, NORTH VANCOUVER, BC, ON MONDAY, DECEMBER 14, 2020 AT 5:30 PM. Retrieved from https://www.cnv.org/-/media/City-of-North-Vancouver/Documents/Council-Meeting-Agenda/2020/2020-12-14-Regular-Agenda-Package-for-December-14-2020.ashx pp.157
[184] City of North Vancouver. (2020). AGENDA FOR THE REGULAR MEETING OF COUNCIL, HELD ELECTRONICALLY FROM CITY HALL, 141 WEST 14TH STREET, NORTH VANCOUVER, BC, ON MONDAY, DECEMBER 14, 2020 AT 5:30 PM. Retrieved from https://www.cnv.org/-/media/City-of-North-Vancouver/Documents/Council-Meeting-Agenda/2020/2020-12-14-Regular-Agenda-Package-for-December-14-2020.ashx pp.157
[185] City of North Vancouver. (2020). AGENDA FOR THE REGULAR MEETING OF COUNCIL, HELD ELECTRONICALLY FROM CITY HALL, 141 WEST 14TH STREET, NORTH VANCOUVER, BC, ON MONDAY, DECEMBER 14, 2020 AT 5:30 PM. Retrieved from https://www.cnv.org/-/media/City-of-North-Vancouver/Documents/Council-Meeting-Agenda/2020/2020-12-14-Regular-Agenda-Package-for-December-14-2020.ashx pp.158

3. Public Charging Network

The City of North Vancouver has been successful in meeting infrastructure goals set out in the 2018 electric vehicle strategy. In 2019, the City received financial support from NRCAN to install two additional DCFC stations and three level-2 charging stations for the public.[186] The City also introduced fees to public charging stations to improve the charging turnover rate. These fees also allow the City to cover operating expenses while ensuring that charging prices remain below gas prices.

Expanding the public charging network is necessary to support EV uptake for residents who do not have access to at-home charging. This report will analyze the City's physical demographics and recommend new locations for EV charging. The ultimate goal is to make sure all residents living in MURBs can access a charger within a 5-minute walk of their dwelling.

4. City Fleet and Equipment

The City of North Vancouver identified timelines for replacing current fleet vehicles with electric vehicles. Currently, the fleet has 5 BEVs and 7 PHEVs. This transition will continue as vehicles need to be replaced. Since fleet EVs are not a focus of this report, fleet electrification opportunities will not be analyzed further.

5. Education and Outreach

In the summer of 2019, the City hosted a number of informational and 'ride & drive' events with Metro Vancouver's Emotive EV Outreach Campaign and the Vancouver Electric Vehicle Association.[187] The purpose of these events was to provide an opportunity for residents to experience EV driving and to ask questions about EV charging. These events stopped due to Covid-19, but will likely continue once pandemic restrictions are lifted. The City also expressed interest in improving signage and visibility of EV charging resources.

Education and awareness are important factors that influence EV uptake. It will be important for the City to develop an engagement plan to reduce misconceptions about EVs and EV charging and to make it easier for residents to purchase EVs and install charging infrastructure.

APPENDIX B: PROGRAMS TO SUPPORT EV RETROFITS FOR GARAGE ORPHANS

Level 1 Charging Through Extension Cords

Level 1 charging is the most simple and accessible type of EV charging because it only requires a 120V household outlet. In cases where EV infrastructure is too expensive or not possible to install in a dwelling unit, some homeowners have opted to charge their EV through extension cords. If

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[186] City of North Vancouver. (2020). AGENDA FOR THE REGULAR MEETING OF COUNCIL, HELD ELECTRONICALLY FROM CITY HALL, 141 WEST 14TH STREET, NORTH VANCOUVER, BC, ON MONDAY, DECEMBER 14, 2020 AT 5:30 PM. Retrieved from https://www.cnv.org/-/media/City-of-North-Vancouver/Documents/Council-Meeting-Agenda/2020/2020-12-14-Regular-Agenda-Package-for-December-14-2020.ashx pp.160
[187] City of North Vancouver. (2020). AGENDA FOR THE REGULAR MEETING OF COUNCIL, HELD ELECTRONICALLY FROM CITY HALL, 141 WEST 14TH STREET, NORTH VANCOUVER, BC, ON MONDAY, DECEMBER 14, 2020 AT 5:30 PM. Retrieved from https://www.cnv.org/-/media/City-of-North-Vancouver/Documents/Council-Meeting-Agenda/2020/2020-12-14-Regular-Agenda-Package-for-December-14-2020.ashx pp.162

managed correctly, this method of charging can effectively provide at-home charging for garage orphans. Level 1 charging through extension cords has been implemented in Vancouver and Seattle. Both cities developed guidelines and made bylaw amendments to ensure extension cord charging is safe and regulated. This charging method was supported to improve at-home charging rates and has also been necessary to reduce illegal at-home charging infrastructure.[188]

Seattle

The City of Seattle introduced guidelines for level 1 charging using extension cords in 2019. Single and multi-family ground-level residences can charge EVs using an extension cord that crosses the public right-of-way (the sidewalk).[189] All parts of the cord that run over the sidewalk must be covered in a highly visible and secure cable ramp that is no taller than ½ an inch above the rest of the sidewalk. The cover must also be at least 4 feet long and have a grade of less than 50% to ensure pedestrian mobility is not impeded.[190] This program only allows level 1 charging. Level 2 charging cords are not permitted to cross the public right-of-way.[191]

EV drivers that charge using extension cords must abide by city bylaws. This means that drivers cannot reserve a parking space on the street and must follow all posted parking restrictions. When the vehicle is not charging, the cord and any other charging equipment must be removed from the public right-of-way.[192]

Vancouver

In 2021, the City of Vancouver developed and approved a license that allows residents to charge their EV using an extension cord that crosses over the public right-of-way. This new program has not been formally initiated but will be launched once an online platform is developed for issuing charging licenses.[193]

This program was adopted due to the prevalence of illegal on-street charging infrastructure that has been installed by EV owners in Vancouver.[194] This infrastructure was often unsafe, as it caused tripping hazards and did not meet electrical safety standards.[195] To combat this problem, the City used Section 289A of the Vancouver Charter to develop a licensing system that overrides the bylaw prohibiting obstruction of the public right-of-way.[196] The guidelines for extension cord charging in Vancouver are based on Seattle's charging program (explained above). Vancouver experienced some pushback from residents who were concerned about pedestrian mobility; however, the City believes that the requirement for mobility-friendly cable covers will ensure that pedestrian movement is not negatively impacted by the program.[197]

[188] Interview with Ian Neville, Senior Sustainability Specialist, City of Vancouver. (2021).
[189] Seattle Department of Transportation. (2019). Electric Vehicle Charging Cord Guidance for Crossing the Public Right-of-Way (Ground Floor Residential Use). Retrieved from https://www.seattle.gov/Documents/Departments/SDOT/CAMs/CAM2119.pdf pp. 1
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[191] Seattle Department of Transportation. (2019). Electric Vehicle Charging Cord Guidance for Crossing the Public Right-of-Way (Ground Floor Residential Use). Retrieved from https://www.seattle.gov/Documents/Departments/SDOT/CAMs/CAM2119.pdf pp.2
[192] Seattle Department of Transportation. (2019). Electric Vehicle Charging Cord Guidance for Crossing the Public Right-of-Way (Ground Floor Residential Use). Retrieved from https://www.seattle.gov/Documents/Departments/SDOT/CAMs/CAM2119.pdf pp.2
[193] Interview with Ian Neville, Senior Sustainability Specialist, City of Vancouver. (2021).
[194] City of Vancouver. (2021). Report – License for Covered Electrical Cords for Electric Vehicle Charging, Climate Emergency: 2021 Feb 9. Retrieved from https://council.vancouver.ca/20210209/documents/r2.pdf pp.3
[195] City of Vancouver. (2021). Report – License for Covered Electrical Cords for Electric Vehicle Charging, Climate Emergency: 2021 Feb 9. Retrieved from https://council.vancouver.ca/20210209/documents/r2.pdf pp.3
[196] City of Vancouver. (2021). Report – License for Covered Electrical Cords for Electric Vehicle Charging, Climate Emergency: 2021 Feb 9. Retrieved from https://council.vancouver.ca/20210209/documents/r2.pdf pp.6
[197] Interview with Ian Neville, Senior Sustainability Specialist, City of Vancouver. (2021).

While level 1 charging is the slowest method of recharging EVs, it is also the least expensive and most accessible type of charging; however, there can be safety risks associated with charging through extension cords that should be considered by the City of North Vancouver. Many EV manufacturers recommend against charging vehicles through extension cords due to the risk of overheating and subsequent damage to wires and insulation in a dwelling.[198] EV charging requires a lot of power and thus needs a high-current charging cord to efficiently and safely provide that power. However, most extension cords are designed to provide low-current power and therefore cannot sufficiently or safely be used to charge an EV.[199] EVolution Australia explains that most EVs would require an extension cord of at least 20amps to charge properly; however, there is still a risk of cable damage or electrical fires when using extension cords, even if they have a high amperage.[200] Additionally, the voltage decreases over the length of a cord, meaning that a short 20amp extension cord may be safe, but a longer 20amp extension cord could overheat and cause fires or other damage.[201]

Charging EVs through extension cords may be an option for garage orphans in the City of North Vancouver; however, it would be necessary for the City to outline the risks and develop guidelines for anyone who uses this charging method. Conversely, most residents living in ground-level dwellings without lane access have access to off-street parking. As a result, demand for this type of charging may be extremely limited in North Vancouver.

If the City chooses to implement a licencing program to support charging through extension cords, following the model developed in Vancouver will expedite the planning process.

APPENDIX C: FINANCIAL SUPPORT FOR PURCHASING EVS

There are a number of funding opportunities designed to reduce the cost of purchasing EVs in BC. While these grants do not directly subsidize EV charging infrastructure costs, they make the whole EV uptake process less expensive for new adopters. Money saved from decreased vehicle costs can be used to fund at-home charging for people living in MURBs or single-family homes.

BC Go Electric Passenger Vehicle Rebate

This program provides ‘point-of-purchase rebates for EVs that cost less than $55,000 based on the manufacturer's suggested retail price (MSRP).[202] The purpose of this rebate is to support purchasing of low to mid-price EVs. The program offers two rebates:

- $3,000 for the purchase or lease of a new BEV, hydrogen fuel cell vehicle, or longer-range PHEVs.
- $1,500 for the purchase or lease of shorter-range PHEVs.[203]

[198] Evolution. (n.d.). Can I charge my electric vehicle with an extension cord? Retrieved from https://www.evolutionaustralia.com.au/single-post/can-i-charge-my-electric-vehicle-with-an-extension-cord
[199] Evolution. (n.d.). Can I charge my electric vehicle with an extension cord? Retrieved from https://www.evolutionaustralia.com.au/single-post/can-i-charge-my-electric-vehicle-with-an-extension-cord
[200] Evolution. (n.d.). Can I charge my electric vehicle with an extension cord? Retrieved from https://www.evolutionaustralia.com.au/single-post/can-i-charge-my-electric-vehicle-with-an-extension-cord
[201] Green Car Reports. (2019). Have you ever used an extension cord to plug in your car? Twitter poll results. Retrieved from https://www.greencarreports.com/news/1123520_have-you-ever-used-an-extension-cord-to-plug-in-your-car-twitter-poll-results
[202] Government of British Columbia. (n.d.) Go Electric Vehicle Rebates. Retrieved from https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/transportation-energies/clean-transportation-policies-programs/clean-energy-vehicle-program/passenger-vehicles
[203] Government of British Columbia. (n.d.) Go Electric Vehicle Rebates. Retrieved from https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/transportation-energies/clean-transportation-policies-programs/clean-energy-vehicle-program/passenger-vehicles

Federal Point-of-Sale EV Rebate

The Government of Canada offers two levels of incentive for people who purchase or lease one of 76 eligible EVs. The size of the rebate varies based on the type of vehicle and whether the vehicle is leased for 12, 48, or 36 months. This rebate is only available for EVs with fewer than 7 seats and an MSRP of less than $45,000 or EVs with more than 7 seats with an MSRP of less than $55,000. [204]

- $5,000 for the purchase of BEV, hydrogen fuel cell, or longer-range PHEVs
- $2,500 for the purchase of shorter-range PHEVs[205]

SCRAP-IT BC

SCRAP-IT is a not-for-profit business that operates through external funding. This program encourages BC residents to scrap old cars with poor fuel efficiency and replace them with used or new EVs. The program accepts gas-powered vehicles made in 2001 or older and any vehicles with a fuel consumption rate of 7.2L/100km or greater.[206] Customers apply to the program, scrap their car at a local scrapyard, and purchase an EV through participating dealerships. The rebate is applied at the time of purchase. SCRAP-IT offers a $6,000 rebate for the purchase of new EVs and a $3,000 rebate for the purchase of used EVs.[207]

The City of North Vancouver can increase use of these rebates by actively marketing them through multiple channels including the City's website, Twitter, Facebook, the newspaper, or local billboards. Cost is one of the largest factors that prevent residents from purchasing EVs in BC. Ensuring that North Vancouver residents are aware of the wide variety of rebates may increase EV uptake.

APPENDIX D: RIGHT TO CHARGE LEGISLATION

Ontario, Canada

Ontario introduced Right to Charge legislation in their Condominium Act in 2018 to support renters and strata members who lack access to at-home EV charging. This legislation requires condo corporations to support and approve EV infrastructure applications by 1) responding to the tenant's application within 60 days, 2) providing information and permission to access electrical schematics or the electrical room, and 3) providing an assessment of the application based on the opinion of a qualified professional. If the application meets legal requirements (such as the Electrical Safety Code), is safe, and will not damage or adversely affect the structural integrity of the condo, the condo corporation may not reject the tenant's application.[208]

Approved EV Charging applications must be accompanied by an agreement between the lessor and the lessee. The terms and conditions of the agreement must include:

[204] Government of Canada. (n.d.). Zero-emission vehicles. Retrieved from https://tc.canada.ca/en/road-transportation/innovative-technologies/zero-emission-vehicles#/find/nearest?country=CA
[205] Government of Canada. (n.d.). Zero-emission vehicles. Retrieved https://tc.canada.ca/en/road-transportation/innovative-technologies/zero-emission-vehicles#/find/nearest?country=CA
[206] Scrap-It. (2021). Does My Old Vehicle Qualify for an EV Rebate? Retrieved from https://scrapit.ca/oldvehicleevrebate/
[207] Scrap-It. (2021). EV Rebate Choices. Retrieved from https://scrapit.ca/evincentivechoices/
[208] City of Ontario. (n.d.). Owning a condo. Retrieved from https://www.ontario.ca/page/owning-a-condo

a) An outline of costs and who pays;
b) Responsibilities for use, repair, maintenance costs, and insurance;
c) Who has ownership over the equipment; and
d) Information about the cessation of use.[209]

These terms reduce concerns on the property-owners end about being liable for the costs of EV equipment.

California, United States

In 2014, the State of California approved Assembly Bill No. 2565 to reduce barriers to at-home and off-street charging for people living or working in strata or rental buildings. This bill requires the lessor of the building to approve requests from a lessee to install EV charging infrastructure in the parking space allotted to the lessee.[210] To be approved, the application must comply with federal, state, and local law, applicable zoning requirements, land use requirements, and other restrictions.[211] The lessor is protected from liability and damages through a written agreement with the lessee. This agreement outlines the role of the lessee, including paying for all costs associated with the EV infrastructure, maintaining insurance, and removing the charging station after use as agreed upon with the property owner.[212] This bill applies to both residential and commercial properties that have specified parking areas.

California Assembly Bill No. 2565 is designed to benefit residents living in MURBs who lack access to at-home EV charging. As a result, the law does not apply in buildings that already have EV charging in at least 10% of parking spaces or buildings with fewer than 5 designated parking spaces.[213] In commercial buildings, the bill does not apply for properties with fewer than 50 parking spaces.[214]

Florida, Unites States

In 2020, Florida added a new section to the Condominium Statute (718.113) which prohibits condominium associations from denying reasonable applications to install EV charging infrastructure.[215] Infrastructure may only be installed within the boundaries of the applicant's common element parking area and must comply with electrical and architectural safety standards.[216] Similar to other Right-to-Charge legislation, Florida requires the applicant to pay for all costs, including installation, operation, maintenance, and insurance of the EV infrastructure. However, the condominium association has the power to influence the size and appearance of the infrastructure, as long as these requirements still allow for the charger to be installed.[217] This statute does not necessarily provide a right-to-charge for residents who rent their unit, as they may not have the right to use common elements. However, renters may speak with their landlord, who can apply for EV charging infrastructure on the renter's behalf.[218]

[209] City of Ontario. (2020). Ontario Regulation 48/01 Condominium Act, 1998, S.O. 1998, c. 19. Retrieved from https://www.ontario.ca/laws/regulation/010048#BK78
[210] California Legislative Information. (2014). AB-2565 Rental Property: electric vehicle charging stations. Retrieved from https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201320140AB2565
[211] California Legislative Information. (2014). AB-2565 Rental Property: electric vehicle charging stations. Retrieved from https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201320140AB2565
[212] California Legislative Information. (2014). AB-2565 Rental Property: electric vehicle charging stations. Retrieved from https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201320140AB2565
[213] Astanehe Law. (n.d.). How California Tenants are Charging Electric Vehicles at Home. Retrieved from https://astanehelaw.com/2020/01/21/how-california-tenants-are-charging-electric-vehicles-at-home/
[214] The National Law Review. (2014). California Update: New Laws Give Residential and Commercial Tenants Rights to Install EV Charging Stations and Streamline Residential Solar Permitting. Retrieved from https://www.natlawreview.com/article/california-update-new-laws-give-residential-and-commercial-tenants-rights-to-install
[215] Florida Legislature. (2020). The 2020 Florida Statutes. Retrieved from http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&Search_String=&URL=0700-0799/0718/Sections/0718.113.html
[216] Florida Legislature. (2020). The 2020 Florida Statutes. Retrieved from http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&Search_String=&URL=0700-0799/0718/Sections/0718.113.html
[217] Florida Legislature. (2020). The 2020 Florida Statutes. Retrieved from http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&Search_String=&URL=0700-0799/0718/Sections/0718.113.html
[218] Jimerson Birr. (n.d.). Condominium Law. Retrieved from https://www.jimersonfirm.com/blog/resources/faqs/condominium-law/

APPENDIX E: EV EDUCATION AND AWARENESS PROGRAMS

Organizations

Plug-In BC & BC Hydro

Plug-In BC provides online guidelines about the selection, installation, and maintenance of EV charging infrastructure for building owners, managers, and residents living in MURBs.[219] The Plug-In BC website also shares information on incentives, public charger locations, and the basics of EVs. These guides can be used as an educational source by municipalities and can also be linked on municipal websites.

Similar to Plug-In BC, BC Hydro offers guides for installing EV charging in MURBs, including preparing the request to the strata council, information on rebates, and the steps for properly installing EV chargers if the request is approved.[220] This information can also be linked on municipal websites to support residents who want to install EV charging.

Metro Vancouver

The EV Strata Condo webpage provides guidance for EV owners, strata councils, and property managers about installing EV charging infrastructure. This site includes a 'challenges and solutions' section that answers frequently asked questions and concerns about installing EV charging in MURBs.[221] These guides are similar to those provided by BC Hydro and Plug-In BC and can also be used as a basis for municipal education programs.

Natural Resources Canada

NRCAN developed the Zero Emissions Vehicle Awareness Initiative (ZEVAI) to improve education and awareness about EVs and EV charging in Canada. This initiative provides funding for governments and businesses to support innovative knowledge-sharing projects. Provincial, regional, and municipal governments can receive funding up to 75% of the total project cost.[222]

Projects that can be funded by the initiative include, but are not limited to, the following:[223]
- Developing a targeting outreach awareness campaign (such as for MURBs)
- Developing a website or web-based tool
- Developing an EV test drive program
- Operating EV showcase facilities that display different vehicles and charging infrastructure
- Implementing a regional EV mentorship program
- Developing a project to improve workplace EV charging awareness
- Developing best practices guides

Applications for this initiative are open until August 16, 2021. Applications can be sent in through the NRCAN website and must include a 200-word summary of the proposal.

[219] Plug In BC. (2021). Installing Electric Vehicle Charging in your Building. Retrieved from https://pluginbc.ca/wp/wp-content/uploads/2021/01/Installing_Electric_Vehicle_Charging_MURB.pdf
[220] BC Hydro. (n.d.). Request EV charging in your condo or strata building. Retrieved from https://electricvehicles.bchydro.com/charge/request-EV-charging-in-apartment-strata
[221] Metro Vancouver. (n.d.). Challenges & Solutions EV Condo. Retrieved from http://www.metrovancouver.org/services/air-quality/climate-action/climate-solutions/ev-strata-condo/challenges-solutions/Pages/default.aspx
[222] Government of Canada. (2021). Zero Emissions Vehicle Awareness Initiative. Retrieved from https://www.nrcan.gc.ca/energy-efficiency/transportation-alternative-fuels/electric-and-alternative-fuel-infrastructure/zero-emission-vehicle-awareness-initiative/22209
[223] Government of Canada. (2021). Zero Emissions Vehicle Awareness Initiative. Retrieved from https://www.nrcan.gc.ca/energy-efficiency/transportation-alternative-fuels/electric-and-alternative-fuel-infrastructure/zero-emission-vehicle-awareness-initiative/22209
[

Emotive

Emotive is an EV outreach and education program run by the Province of BC that offers EV education events, videos, and written guides about owning an EV. On top of these educational materials, the website also links resources from Plug-In BC, BC Hydro, and Clean BC.[224]

Emotive also has a Community Outreach Program (COIP) that offers support and funding to BC communities, organizations, and municipalities to assist with developing and delivering EV awareness campaigns.[225] The funding is intended to help deliver Emotive campaign activities including general awareness events and clean transportation planning.[226]

The program offers three levels of funding, including:

- $5,000 for EV outreach activities.
- $10,000 for campaigns that span across multiple communities.
- $20,000 for indigenous governments to develop clean transportation targets, plans, and policies that will be incorporated into public-facing strategic documents.[227]

Emotive has partnered with municipalities, including the City of North Vancouver, to provide EV driving opportunities and to answer resident questions about purchasing vehicles or EV charging infrastructure. These events will be an important part of the City's marketing initiatives after covid restrictions are removed.

Municipalities

Saanich

The City of Saanich has improved education and awareness of EVs through a number of initiatives such as open houses, surveys, driving events, and media promotion. For example, Saanich ran a climate plan engagement event in 2019 that included a number of presentations about the benefits of EV ownership. After the event, participants were surveyed on their interest in purchasing an EV in the future, with 19 out of 23 stating that they would be more likely to purchase an EV or other low-carbon transportation method after watching the presentation.[228] The City also ran a more detailed survey about low emission transportation that was marketed online, through the local newspaper, and during two open house events. The results of this survey showed that 231 respondents (82%) supported an increase in public and private EV charging stations.[229] Other written responses showed further support for EVs along with some concerns about congestion, manufacturing emissions, and cost.[230]

Similar to the City of North Vancouver, Saanich has identified promotional and educational events including 'ride and drive' events as a high priority in their 2020 EV strategy.[231] Additionally, the City is working on a communications campaign that will include:

- Short videos, testimonials, presentations, sound-bytes, and informative posters that outline the benefits of EVs;
- Media promotion of EVs and the City's charging network; and
- Support for car dealerships to have EVs available for test drives.[232]

[224] Emotive. (n.d.). Live the Electric Life. Retrieved from https://www.emotivebc.ca/
[225] Plug In BC. (2021). Emotive Community Outreach Incentive Program. Retrieved from https://pluginbc.ca/community-outreach-incentive-program-2021/
[226] Plug In BC. (2021). Emotive Community Outreach Incentive Program. Retrieved from https://pluginbc.ca/community-outreach-incentive-program-2021/
[227] Plug In BC. (2021). Emotive Community Outreach Incentive Program. Retrieved from https://pluginbc.ca/community-outreach-incentive-program-2021/
[228] District of Saanich. (2019). 100% Renewable & Resilient Saanich – Phase 2 Engagement Report. Retrieved from https://www.saanich.ca/assets/Community/Documents/Planning/sustainability/Climate-Plan-Phase-2-Engagement-Report.pdf pp. 17
[229] District of Saanich. (2019). 100% Renewable & Resilient Saanich – Phase 2 Engagement Report. Retrieved from https://www.saanich.ca/assets/Community/Documents/Planning/sustainability/Climate-Plan-Phase-2-Engagement-Report.pdf pp. 64
[230] District of Saanich. (2019). 100% Renewable & Resilient Saanich – Phase 2 Engagement Report. Retrieved from https://www.saanich.ca/assets/Community/Documents/Planning/sustainability/Climate-Plan-Phase-2-Engagement-Report.pdf pp. 84-152
[231] District of Saanich. (2020). 100% Renewable & Resilient Saanich. Retrieved from https://www.saanich.ca/assets/Community/Documents/Planning/sustainability/E-Mobility-Strategy-web.pdf pg. 43
[232] District of Saanich. (2020). 100% Renewable & Resilient Saanich. Retrieved from https://www.saanich.ca/assets/Community/Documents/Planning/sustainability/E-Mobility-Strategy-web.pdf pp. 43

Finally, the city is planning to provide EV charging infrastructure education and resource materials to strata councils/members, rental apartment building owners, and the Vancouver Island Strata Owners Association to support EV charging in existing MURBs.[233]

City of Vancouver

The City of Vancouver identified a lack of awareness as a major barrier to EV adoption in their 2016 EV Ecosystem Strategy.[234] The City identified two primary actions to improve awareness in this plan, including 1) Developing a workplace charging challenge and 2) Installing 'EHubs' throughout the city. The workplace charging challenge involves the creation of an information campaign that targets employers and building managers in commercial properties to expand EV charging access.[235] The goal is to improve the public charging network by explaining the benefits of providing EV charging. This program has not yet been implemented in Vancouver.

The public charging points, or 'EHubs', will be used as information sources for non-EV drivers. The City plans to install multiple public charging hubs with highly visible designs that can be used as canvases for information and public art.[236] The unique designs will increase awareness of these stations and information boards at the charging sites will be used to outline the benefits of EV ownership. Improving the visibility of public charging stations will decrease concerns about limited charging stations.

APPENDIX F: ON-STREET CHARGING STATIONS IN FRONT OF PROPERTY

Vancouver, Canada

The City of Vancouver ran a pilot program in 2018 to provide administrative support for businesses to install EV chargers on city-owned land. Businesses that signed up for the program paid for all installation fees and a $200 licensing fee. In return, the business was not required to obtain a building or development permit.[237] However, all participants were required to obtain an electrical permit and follow all city design guidelines.[238] These charging stations were required to be publicly accessible and free-use, meaning that the business could not sell the use of electricity, as stipulated under the Utilities Commission Act.[239]

The pilot project was fairly successful, with 4 DCFC charging stations out of 5 supported by the city being built in 2 years.[240] One of the main barriers to uptake was the cost of the infrastructure. Since businesses were not allowed to charge fees for use of their charging stations, they were unable to recoup the cost of their investment.[241] In order for this program to be successful in the future, the Utilities Commission Act (UCA) needed to be amended to allow for the resale of electricity by businesses. Order G-66-19 was approved in March 2019 to amend sections 88(1) and 88(3) of the UCA and included the following changes:[242]

[233] District of Saanich. (2020). 100% Renewable & Resilient Saanich. Retrieved from https://www.saanich.ca/assets/Community/Documents/Planning/sustainability/E-Mobility-Strategy-web.pdf pp.46
[234] City of Vancouver. (2016). Vancouver's EV Ecosystem Strategy. Retrieved from https://vancouver.ca/files/cov/ev-ecosystem-strategy.pdf pp. 27
[235] City of Vancouver. (2016). Vancouver's EV Ecosystem Strategy. Retrieved from https://vancouver.ca/files/cov/ev-ecosystem-strategy.pdf pp. 34
[236] City of Vancouver. (2016). Vancouver's EV Ecosystem Strategy. Retrieved from https://vancouver.ca/files/cov/ev-ecosystem-strategy.pdf pp. 44
[237] City of Vancouver. (2018). Curbside Electric Vehicle Supply Equipment Pilot Program Guidelines. Retrieved from https://vancouver.ca/files/cov/curbside-evse-pilot-guidelines.pdf pp. 1
[238] City of Vancouver. (2018). Curbside Electric Vehicle Supply Equipment Pilot Program Guidelines. Retrieved from https://vancouver.ca/files/cov/curbside-evse-pilot-guidelines.pdf pp. 2
[239] City of Vancouver. (2018). Curbside Electric Vehicle Supply Equipment Pilot Program Guidelines. Retrieved from https://vancouver.ca/files/cov/curbside-evse-pilot-guidelines.pdf pp. 3
[240] Interview with Ian Neville, Senior Sustainability Specialist, City of Vancouver. (2021).
[241] Interview with Ian Neville, Senior Sustainability Specialist, City of Vancouver. (2021).
[242] British Columbia Utilities Commission. (2019). An Inquiry into the Regulation of Electric Vehicle Charging Service. Retrieved from https://www.bcuc.com/Documents/Proceedings/2019/DOC_53649_G-66-19-BCUC-EV-Inquiry-Exemption.pdf pp. 1

• A person is exempt from Part 3 of the UCA with respect to the sale, delivery, or provision of electricity for EV charging services to or for the public or a corporation for compensation, except for the provisions of sections 25 and 38 relating to safety only, in the class of cases where the person is not otherwise a public utility under the UCA.[234]

• A person is exempt from Part 3 of the UCA with respect to the sale, delivery, or provision of electricity for EV charging services to or for the public or a corporation for compensation, except for the provisions of sections 25 and 38 relating to safety only, in the class of cases where the person is a landlord or a strata corporation that is a public utility under the UCA solely because of the services offered in its capacity as a landlord or a strata corporation.[244]

• The exemption granted pursuant to this order shall remain in effect until the BCUC, on its own motion, or upon receiving a complaint from a person whose interests are affected, and after a hearing, determines the exemption shall no longer apply in whole or in part.[245]

With this change to the UCA, the licensing program will likely become more permanent and affordable for businesses in the future.

US Department of Energy

The US Department of Energy, Centre for Climate and Energy Solutions, and the National Association of State Energy Officials collaborated on a guidance document in 2015 to support the installation of EV charging stations in front of businesses. The document outlined that providing EV charging can improve financial performance by increasing sales and business exposure, but may have a long payback period due to low EV adoption rates.[246] As EV adoption increases, the payback period will continue to improve; however, limited revenue gain is currently a disincentive for businesses to install EV charging infrastructure.

In the short term, it is necessary for municipal and state/provincial governments to provide interventions such as grants, loans, and other incentives that encourage residents to purchase EVs and businesses to provide EV charging.[247] For example, a municipal government may be able to provide low or no-interest loans on EV charging equipment purchased by local businesses.[248] This model has been considered in some BC communities but has not been formally implemented. One opportunity in BC would be to collaborate with the credit union, Vancity, which often supports local sustainability initiatives.[249] In fact, Vancity has an environmental commitment to provide funding for governments to implement public policy that reduces negative environmental impacts.[250]

In addition to financial support, the guidance document also recommends business models to reduce installation costs or increase revenues from EV charging infrastructure.

[243] British Columbia Utilities Commission. (2019). An Inquiry into the Regulation of Electric Vehicle Charging Service. Retrieved from https://www.bcuc.com/Documents/Proceedings/2019/DOC_53649_G-66-19-BCUC-EV-Inquiry-Exemption.pdf pp. 2
[244] British Columbia Utilities Commission. (2019). An Inquiry into the Regulation of Electric Vehicle Charging Service. Retrieved from https://www.bcuc.com/Documents/Proceedings/2019/DOC_53649_G-66-19-BCUC-EV-Inquiry-Exemption.pdf pp.2
[245] British Columbia Utilities Commission. (2019). An Inquiry into the Regulation of Electric Vehicle Charging Service. Retrieved from https://www.bcuc.com/Documents/Proceedings/2019/DOC_53649_G-66-19-BCUC-EV-Inquiry-Exemption.pdf pp. 2
[246] Centre for Climate and Energy Solutions. (2015). Strategic Planning to Implement Publicly Available EV Charging Stations: A Guide for Businesses and Policymakers. Retrieved from https://www.c2es.org/document/strategic-planning-to-implement-publicly-available-ev-charging-stations-a-guide-for-businesses-and-policymakers/ pp. vii
[247] Centre for Climate and Energy Solutions. (2015). Strategic Planning to Implement Publicly Available EV Charging Stations: A Guide for Businesses and Policymakers. Retrieved from https://www.c2es.org/document/strategic-planning-to-implement-publicly-available-ev-charging-stations-a-guide-for-businesses-and-policymakers/ pp. viii
[248]Centre for Climate and Energy Solutions. (2015). Strategic Planning to Implement Publicly Available EV Charging Stations: A Guide for Businesses and Policymakers. Retrieved from https://www.c2es.org/document/strategic-planning-to-implement-publicly-available-ev-charging-stations-a-guide-for-businesses-and-policymakers/. pp. X
[249] Interview with Brendan McEwan, AES Engineering. (2021).
[250] Vancity. (n.d.). Environmental Sustainability. Retrieved from https://www.vancity.com/AboutVancity/VisionAndValues/ValuesBasedBanking/EnvironmentalSustainability/

Sales boost business model – Authors of the report suggest that automakers should provide a small amount of funding for businesses to install EV charging infrastructure.[251] Companies that produce EVs will benefit from public EV charging because it encourages uptake and results in more profits. This model would require strong support from the federal government and may result in an increase in EV prices. However, EV automakers including Nissan, BMW, and Volkswagen have all subsidized DCFC charging in the past, suggesting that automakers may be receptive to offering additional subsidies.[252]

Revenue sharing business model – This model recommends that a group of businesses in close proximity to each other should either equally invest in a charging station and share the profits or send a portion of their increased sales profits to the station owner on an annual basis.[253] Charging stations are a benefit to all businesses in the area, especially if they are located in a popular tourist destination. While drivers wait for their vehicle to charge, they will shop or dine at the local stores, restaurants, and cafes and increase revenues in these businesses. Businesses involved in this model would also receive direct revenues from charging service fees.[254] Depending on the demand for the station, this business model could provide a better return on investment for all shops involved.

APPENDIX G: STREETLIGHT POLE EV CHARGING

New Westminster

The British Columbia Institute of Technology (BCIT) collaborated with the City of New Westminster to pilot curbside EV charging using streetlight infrastructure. The purpose of this project was to provide a charging option for garage orphans, who do not have the option to charge an EV at home.[255]

Identifying potential neighbourhoods to host EV charging infrastructure was one of the largest barriers to implementing the project. Many of the streetlight bulbs in New Westminster were either Metal Halide or High Pressure Sodium, which cannot support EV charging.[256] Areas of the city that had LED streetlights often either had off-street residential parking or poles that were placed on the far side of the sidewalk from the road.[257] As a result, street poles that were chosen for the program had to receive LED retrofits, occasional wire upgrades, and occasional branch breaker upgrades.[258] Each charging station cost approximately $4,000 CAD and included EVEMS technology and a retractable cord.[259] These technologies were chosen to ensure that the electrical capacity of the light service panel would not be overloaded during peak hours. The retractable cord reduces the chance that the plug will be run over by a vehicle and also reduces tripping hazards on the public right of way.

[252] [Centre for Climate and Energy Solutions. (2015). Strategic Planning to Implement Publicly Available EV Charging Stations: A Guide for Businesses and Policymakers. Retrieved from https://www.c2es.org/document/strategic-planning-to-implement-publicly-available-ev-charging-stations-a-guide-for-businesses-and-policymakers/ pp. 27
[253] Centre for Climate and Energy Solutions. (2015). Strategic Planning to Implement Publicly Available EV Charging Stations: A Guide for Businesses and Policymakers. Retrieved from https://www.c2es.org/document/strategic-planning-to-implement-publicly-available-ev-charging-stations-a-guide-for-businesses-and-policymakers/ pp. ix
[254] Centre for Climate and Energy Solutions. (2015). Strategic Planning to Implement Publicly Available EV Charging Stations: A Guide for Businesses and Policymakers. Retrieved from https://www.c2es.org/document/strategic-planning-to-implement-publicly-available-ev-charging-stations-a-guide-for-businesses-and-policymakers/ pp. 30
[255] Howey, Clay. (2018). Innovations in Electric Vehicle Charging. Retrieved from https://www.bcit.ca/files/appliedresearch/pdf/2-evi-workshop-02-22-2017-siting.pdf
[256] Howey, Clay. (2018). Innovations in Electric Vehicle Charging. Retrieved from https://www.bcit.ca/files/appliedresearch/pdf/2-evi-workshop-02-22-2017-siting.pdf
[257] Howey, Clay. (2018). Innovations in Electric Vehicle Charging. Retrieved from https://www.bcit.ca/files/appliedresearch/pdf/2-evi-workshop-02-22-2017-siting.pdf
[258] Howey, Clay. (2018). Innovations in Electric Vehicle Charging. Retrieved from https://www.bcit.ca/files/appliedresearch/pdf/2-evi-workshop-02-22-2017-siting.pdf
[259] Puentes, Andres. (2019). On-Street Electric Vehicle Charging from Light Poles. Retrieved from https://sustain.ubc.ca/sites/default/files/2019-60_On-Street%20Electric%20Vehicle%20Charging_Puentes.pdf pp.18

California

The California Bureau of Street Lighting has installed EV charging infrastructure on 431 LED streetlights in Los Angeles to date.[260] These stations were part of a city-wide initiative to expand the public charging network, aiding the goal of providing 10,000 commercial chargers by 2022, which was exceeded in 2021.[261] EV charging stations in Los Angeles are heavily subsidized through grants from the California Air Resources Board and the California Energy Commission.[262] The Los Angeles Department of Water and Power (LADWP) also offers large rebates for commercial entities to install public EV chargers in front of their building, including $5,000 for level 2 (including streetlight pole chargers) and $75,000 for DCFC.[263]
Streetlight poles were chosen to host EV charging equipment to limit the amount of infrastructure built on the sidewalk.[264] The fee for using charging stations is most commonly $1 or $2 per hour and curbside parking is free.[265]

Toronto

In 2017, the City of Toronto began working with Toronto Hydro to develop a plan to install 6 public EV charging stations on streetlight poles. The poles would have either 1 or 2 charging plugs, with a total of 11 EV-serviced parking spaces. The areas chosen for this project were identified based on the availability of parking permits, parking restrictions, the presence and location of streetlight poles, the ability for two cars to park end-to-end, and the available electrical capacity.[266]

EVs using these stations will be required to follow all posted parking restrictions, including time limits. The City of Toronto implemented site-specific bylaw amendments to limit parking in unregulated areas to 12 hours.[267] This amendment will ensure that there will be turnover at the EV charging stations and may also allow residents to charge their vehicles overnight. The infrastructure and installation will be funded by Toronto Hydro. The company will recoup those costs by charging an hourly rate for use of the charger.[268] Funding for the signage and pavement markings will be provided by the City of Toronto's Transportation Service Operating Budget.[269]

Vancouver

The City of Vancouver is analyzing the opportunity to install streetlight pole charging for carshare programs and potentially for public charging in the future.[270] This program would be aligned with

[260] City of Los Angeles. (2020). EV Charging Stations. Retrieved from. http://bsl.lacity.org/smartcity-ev-charging.html
[261] Spectrum News. (2021). LA Now Has 10,000 Commercial EV Chargers, Two Years Earlier Than Planned. Retrieved from https://spectrumnews1.com/ca/la-west/transportation/2021/01/05/la-now-has-10-000-public-electric-vehicle-chargers--1-1-2-years-earlier-than-planned
[262] Electrek. (2019). LA adds hundreds of EV chargers to streetlights, giving renters a place to plug in. Retrieved from https://electrek.co/2019/11/13/la-adds-hundreds-of-ev-chargers-to-streetlights-giving-renters-a-place-to-plug-in/
[263] Spectrum News. (2021). LA Now Has 10,000 Commercial EV Chargers, Two Years Earlier Than Planned. Retrieved from https://spectrumnews1.com/ca/la-west/transportation/2021/01/05/la-now-has-10-000-public-electric-vehicle-chargers--1-1-2-years-earlier-than-planned
[264] Spectrum News. (2021). LA Now Has 10,000 Commercial EV Chargers, Two Years Earlier Than Planned. Retrieved from https://electrek.co/2019/11/13/la-adds-hundreds-of-ev-chargers-to-streetlights-giving-renters-a-place-to-plug-in/
[265] Spectrum News. (2021). LA Now Has 10,000 Commercial EV Chargers, Two Years Earlier Than Planned. Retrieved from https://electrek.co/2019/11/13/la-adds-hundreds-of-ev-chargers-to-streetlights-giving-renters-a-place-to-plug-in/
[266] City of Toronto. (2018). Residential On-Street Electric Vehicle Charging Stations – Parking Amendments – Delegated Locations. Retrieved from https://www.toronto.ca/legdocs/mmis/2018/te/bgrd/backgroundfile-115559.pdf pp. 3
[267] City of Toronto. (2018). Residential On-Street Electric Vehicle Charging Stations – Parking Amendments – Delegated Locations. Retrieved from https://www.toronto.ca/legdocs/mmis/2018/te/bgrd/backgroundfile-115559.pdf pp. 4
[268] City of Toronto. (2018). Residential On-Street Electric Vehicle Charging Stations – Parking Amendments – Delegated Locations. Retrieved from https://www.toronto.ca/legdocs/mmis/2018/te/bgrd/backgroundfile-115559.pdf pp. 3
[269] City of Toronto. (2018). Residential On-Street Electric Vehicle Charging Stations – Parking Amendments – Delegated Locations. Retrieved from https://www.toronto.ca/legdocs/mmis/2018/te/bgrd/backgroundfile-115559.pdf pp. 3
[270] Interview with Ian Neville, Senior Sustainability Specialist, City of Vancouver. (2021).

the City's plans to add LED retrofits to older streetlights, which will decrease the electrical load of the poles by approximately 50% and provide enough power to support level 2 EV chargers.[271] A feasibility analysis on adding EV charging to streetlight poles was conducted in 2019 to determine challenges, opportunities, and next steps for implementing this program. The study found that the infrastructure would be feasible in a limited number of cases. Old and deteriorating infrastructure was prevalent problem identified with the City's streetlights. In many cases, it was noted that the City would need to upgrade the insulation, grounding system, metallic conduit, and service panels of many of the poles to support EV charging.[272] This would be a time-consuming and costly retrofit project. Some streetlight poles are only energized at night, which would significantly limit the number of drivers able to use the charging service. Furthermore, some of the electrical panels simply do not have the capacity to support a level 2 charger.[273]

Finally, BC Hydro will require a metering device to be installed on any light poles used to power EV charging infrastructure. The City of Vancouver (and most other cities that use streetlight poles powered by BC Hydro) pay a flat rate to power these lights. When EV charging also draws power from the service panels, the rate can no longer be calculated without metering devices.[274] The City of Vancouver will not install any EV charging infrastructure on streetlight poles until there are more discussions with BC Hydro and an actionable plan is developed. Some potential locations have already been identified through the feasibility analysis, but they may change once a plan is made.

APPENDIX H: GAS STATIONS WITH EV CHARGING INFRASTRUCTURE

BP Chargemaster (United Kingdom)

BP offers EV charging services in the United Kingdom through their subsidiary company, BP Chargemaster. BP took on EV charging to support the growing market of EVs in the UK.[275] The company plans to install 400 DCFC stations in BP gas stations across the United Kingdom by the end of 2021.[276] BP states that EVs will only need to stop and charge for 10-12 minutes, which is only slightly longer than the 7-minute average time spent at gas stations by gas-powered vehicle owners.[277]

If the City of North Vancouver chooses to support EV charging in gas stations, it will be important to consider charging needs, comfort, and station turnover. Non-EV drivers are experienced with stopping at a gas station for 5-10 minutes to refuel their vehicle. If DCFC stations are installed, new EV drivers would not need to significantly change their driving habits to recharge their EV. Furthermore, if drivers see that the queue for recharging has a fast turnover rate, there will be less concern about having to wait for long periods of time.

[271] Puentes, Andres. (2019). On-Street Electric Vehicles Charging from Light Poles. Retrieved from https://sustain.ubc.ca/sites/default/files/2019-60_On-Street%20Electric%20Vehicle%20Charging_Puentes.pdf pp. 19
[272] Puentes, Andres. (2019). On-Street Electric Vehicles Charging from Light Poles. Retrieved from https://sustain.ubc.ca/sites/default/files/2019-60_On-Street%20Electric%20Vehicle%20Charging_Puentes.pdf pp. 27
[273]Interview with Ian Neville, Senior Sustainability Specialist, City of Vancouver. (2021).
[274] Puentes, Andres. (2019). On-Street Electric Vehicles Charging from Light Poles. Retrieved from https://sustain.ubc.ca/sites/default/files/2019-60_On-Street%20Electric%20Vehicle%20Charging_Puentes.pdf pg. 27
[275] BP Pulse. (2019). BP Chargemaster continues to grow, rolling out ultra-fast charging on BP forecourts across the UK. Retrieved from https://bpchargemaster.com/bp-chargemaster-continues-to-grow-rolling-out-ultra-fast-charging-on-bp-forecourts-across-the-uk/
[276] Charged EVs. (2019) BP Chargemaster installs first of 400 150 kW chargers. Retrieved from https://chargedevs.com/newswire/%ef%bb%bfbp-chargemaster-installs-first-of-400-150-kw-chargers/
[277] Charged EVs. (2019) BP Chargemaster installs first of 400 150 kW chargers. Retrieved from https://chargedevs.com/newswire/%ef%bb%bfbp-chargemaster-installs-first-of-400-150-kw-chargers/

Shell & Greenlots (Singapore)

Shell acquired the EV charging company, Greenlots, in early 2019 to support EV charging at their gas stations.[278] The two companies have been working together to expand EV charging networks in Singapore and other countries in Southeast Asia. They believe that providing EV charging in gas stations will accelerate EV adoption by residents, ridesharing companies, and commercial fleets.[279] DCFC is currently available at 18 gas stations in Singapore.[280] Shell has announced plans to expand charging to half of the 57 gas stations in the country by the end of 2021.[281] This plan supports the government of Singapore's goal to deploy 60,000 EV charging stations across the country by 2030.[282] However, the government is not providing funding support for this venture.

Gas companies are starting to add EV charging to their fueling stations to reap the benefits of highly demanded charging plugs. If government policies continue to support EV charging and EV uptake, gas companies in Canada may also begin installing EV charging in gas stations. The City of North Vancouver may not need to financially support EV chargers at gas stations, depending on current gas company plans and interest.

Germany

Germany is supporting EV adoption by planning to have 1 million charging stations available across the country by 2030.[283] The German government adopted a number of measures to support this ambitious goal, including requiring all 14,000 gas stations in the country to provide EV charging stations.[284] This requirement was put in place to reduce range anxiety, which was identified as a key factor dissuading residents from purchasing EVs.[285]

This project is part of the country's 130 billion Euro stimulus programme, which was designed to stimulate the economy after the impact of Covid-19.[286] The programme sets aside 50 billion Euros to 'invest in a future-friendly Germany' and includes measures such as increasing rebates on the purchase of EVs, investing 2.5 billion Euros into EV charging stations and electric mobility R&D, and supporting EV fleets.[287] There is little information available about the progress of the gas station retrofits; however, Aral AG (a subsidiary of BP in Germany) announced their partnership with Siemens to upgrade gas station grids and install over 100 ultra-fast charging stations in 30 gas stations during the first quarter of 2021.[288] The companies decided that ultra-fast charging (known as DCFC in Canada) is the most appropriate type of EV charging in a gas station to maintain a high turnover of vehicles and to make charging as fast as refueling a gas-powered vehicle.[289] Ensuring that EV charging is similar to refueling at gas stations will reduce the number of habits drivers much change when they transition to an EV. This may ease the

[278] Charged EVs. (2019) BP Chargemaster installs first of 400 150 kW chargers. Retrieved from https://chargedevs.com/newswire/shells-greenlots-installs-first-abb-ev-fast-charger-in-singapore/
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[280] Shell. (n.d.). Welcome to Shell Recharge. Retrieved from https://www.shell.com.sg/motorists/welcome-to-shell-recharge.html
[281] Channel News Asia. (2021). Shell to install EV charging points as half its petrol stations in Singapore. Retrieved from https://www.channelnewsasia.com/news/videos/shell-to-install-ev-charging-points-at-half-its-petrol-stations-14438948
[282] Singapore Land Transport Authority. (2021). Factsheet: Accelerating Nationwide Deployment of Electric Vehicle Charging Points. Retrieved from https://www.lta.gov.sg/content/ltagov/en/newsroom/2021/3/news-release/Accelerating_nationwide_deployment_of_electric_vehicle_charging_points.html
[283] The Federal Government of Germany. (n.d.). Expanding the charging infrastructure for electric mobility. Retrieved from https://www.bundesregierung.de/breg-en/issues/climate-action/verkehr-1674024
[284] Inside EVs. (2020). Should Electric Car Chargers Be Installed at Gas Stations. Retrieved from https://insideevs.com/features/457944/electric-vehicle-chargers-gas-stations/
[285] Reuters. (2020). Germany will require all petrol stations to provide electric car charging. Retrieved from https://www.reuters.com/article/us-health-coronavirus-germany-autos/germany-will-require-all-petrol-stations-to-provide-electric-car-charging-idUSKBN23B1WU
[286] Germany Federal Ministry of Finance. (n.d.). Emerging from the crisis with full strength. Retrieved from https://www.bundesfinanzministerium.de/Content/EN/Standardartikel/Topics/Public-Finances/Articles/2020-06-04-fiscal-package.html
[287] Germany Federal Ministry of Finance. (n.d.). Emerging from the crisis with full strength. Retrieved from https://www.bundesfinanzministerium.de/Content/EN/Standardartikel/Topics/Public-Finances/Articles/2020-06-04-fiscal-package.html
[288] Siemens. (2021). Siemens and Aral ready gas stations for mobility of the future. Retrieved from https://press.siemens.com/global/en/pressrelease/siemens-and-aral-ready-gas-stations-mobility-future
[289] Siemens. (2021). Siemens and Aral ready gas stations for mobility of the future. Retrieved from https://press.siemens.com/global/en/pressrelease/siemens-and-aral-ready-gas-stations-mobility-future

transition and reduce misconceptions about the effort required to own and recharge an EV.

South Korea

Hyundai has been installing EV charging infrastructure in South Korean cities including Seoul, Daegu, and Busan.[290] The company's oil refining division, Hyundai Oilbank, formed an agreement with two other refiners in Korea to install and operate 10 DCFC stations at gas stations and large retail stores by the end of 2020.[291] The group of businesses is now planning to install EV chargers at 2,300 Hyundai Oilbank-owned gas stations in South Korea, supporting the EV charging network in the country.[292] A start or end date for this project has not been identified.

This example of EV charging being added to gas stations is driven by Oil companies rather than governments. However, it is a good example of how the market for EV charging changes as EVs become more popular. Sharing these examples through educational guidance materials may increase the number of gas stations in North Vancouver that install EV charging.

On the Run Canada

On the Run is a convenience store chain that is often placed next to gas stations in Canada. In 2021, the company announced a plan to install 25 DCFC stations (100 outlets) between Vancouver Island and Calgary by the end of 2022.[293] On the Run believes that access to shopping, food, and wi-fi will provide a comfortable space for EV users to wait while their vehicle charges.[294]

APPENDIX I: AMSTERDAM ON DEMAND EV CHARGER 10-STEP PROCESS

1. The EV driver makes a request online for public charging infrastructure.
2. The area requested is analyzed to make sure the infrastructure will be beneficial. Considerations include:
    - The distance from other public EV chargers, and
    - The occupancy rate of nearby charging stations.
3. City council votes on the new charging location.
4. The installation plan is drawn up by the collaborating companies, Nuon and Heijmans.
5. City council formally accepts installation plan.
6. The location and the plan are published online and communicated with EV drivers.
7. The contractor requests connection to the electrical grid.
8. The Amsterdam council instructs the contractor to install the infrastructure.
9. The soil is surveyed and then the contractor is permitted to begin the installation.
10. The EV Charger is installed.[295]

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[291] The Korea Herald. (2019). Korea oil refiners push into EV charging market. Retrieved from http://www.koreaherald.com/view.php?ud=20190715000565
[292] Charged EVs. (2020). South Korea has fast chargers at 76 gas stations, is planning thousands more. Retrieved from https://chargedevs.com/newswire/south-korea-has-fast-chargers-at-76-gas-stations-is-planning-thousands-more/
[293] Driving. (2021). On the Run convenience stores in B.C to get EV charging stations. Retrieved from https://driving.ca/auto-news/local-content/on-the-run-convenience-stores-in-b-c-to-get-ev-charging-stations
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