

# Capital Region Local Government Electric Vehicle (EV) + Electric Bike (E-Bike) Infrastructure Planning Guide



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Responsibility for the content of this report lies with the authors, and not the individuals nor organizations noted above.

WATT Consulting Group authored the *Backgrounder* and *Infrastructure Planning Guide* documents.

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# 1. Overview

Transportation and mobility are rapidly evolving, driven by a range of factors from climate change, technology, economics, and general consumer preferences. The electrification of transportation is part of this emerging and evolving transportation landscape that has and continues to allow consumers to save significant fuel costs and reduce their overall impact on the environment.

Electric vehicles (EVs) have been emerging over the last 10 years both within the Canadian and global context; in the last three years alone, there has been a 214% year-over-year growth in EV sales in Canada.<sup>1</sup> Increases in EV sales have been accompanied by greater diversity in EV models and improved battery range, which is appealing to a broader range of consumers while simultaneously alleviating range anxiety.

While EVs do not address congestion issues, which continue to plague a number of communities in Canada, they do support community greenhouse gas (GHG) emission reduction goals as the transportation sector typically represents a significant share of GHG emissions. Local governments are uniquely positioned to capitalize on this opportunity to reduce GHG emissions through supporting EV adoption through the provision of public EV charging stations and requirements for new buildings to be EV-ready. Support from local governments is indispensable for increasing EV adoption in the short-term as the EV market continues to develop.

Electric Bikes (E-Bikes) are another emerging transportation phenomenon that are gaining popularity worldwide. Similar to EVs, E-Bikes can help communities achieve their GHG emission reduction targets. Further, with supportive cycling infrastructure in place, E-Bikes have the potential to substitute for, or completely replace, almost all trips taken by a gasoline powered car, which could address congestion issues and mitigate parking challenges within urban areas. However, E-Bikes still face a number of barriers (see [Section 2.3](#)) that are limiting their uptake. Fortunately, local governments can address many of these barriers through policy and planning efforts.

Both EVs and E-Bikes will continue to be critical components of the larger transportation picture and this document outlines how local governments in the Capital Region could have a significant role in helping make these emerging forms of transportation more prevalent in their communities.

### 1.2 About the Project

Working with and on behalf of local governments, the Capital Regional District (CRD) has undertaken the *Electric Vehicle (EV) and Electric Bicycle (E-Bike) Infrastructure Planning Project* to understand and assess opportunities to advance EV and E-Bike charging infrastructure in public and private locations throughout the region. EV and E-Bike technology is rapidly advancing and this project is focused on the current landscape. The key objectives of this project are to:

- Understand opportunities for local governments to accelerate uptake of EVs and E-bikes;
- Collect feedback from the development community and general public to better understand the barriers and opportunities for EV and E-bike charging;
- Draw on resources and lessons learned from other communities;
- Identify priority locations for new EV charging stations in the Capital Region; and
- Create an infrastructure planning guide outlining options for local governments on how to advance EV and E-bike charging infrastructure in the region.

### 1.2 About the Guide

The *Infrastructure Planning Guide* (this document) is the second of two key project outcomes and contains strategies for local governments and electoral areas, as well as private development, to expand EV and E-Bike charging infrastructure in the Capital Region. The *Capital Region EV + E-Bike Infrastructure Planning "Backgrounder"* is a companion to this document. It was developed as a summary of EV / E-Bike research and included examples of best practices from leading jurisdictions, intended to inform this document. Supporting information for many of the conclusions from this document can be found in the Backgrounder.

This document contains the following information:

- An overview of existing EVs and E-bikes, charging station technology, trends in EVs and E-bike ownership in the Capital Region and elsewhere, and key barriers to uptake;
- Prioritized locations for future installation of public EV charging infrastructure and improved management of public EV charging stations;
- Opportunities to increase EV and E-Bike charging infrastructure in new development; and
- Recommended approaches for retrofitting existing buildings for EV charging.

## Capital Region Local Government Electric Vehicle + Electric Bike Infrastructure Planning Guide

Note, while this report only focuses on EV and E-Bikes, reducing distances travelled, reducing the reliance on automobiles, improving vehicle efficiency and switching to low or no greenhouse gas emitting fuels should all be considered as part of a sustainable transportation strategy. Fully hybrid vehicles and fuel cell electric vehicles (FCEVs) are types of electric vehicle that cannot be plugged in and charged and are therefore not included in this document.

With EV and E-Bike and other zero emissions transportation technology rapidly changing, and prices continuing to decline, policy will need to continuously be updated and refined to reflect the latest trends. This document is intended to be a “living document”.

In September, 2018, the City of Richmond procured a document prepared by C2MP, the Fraser Basin Council and AES Engineering titled “[Residential Electric Vehicle Charging: a Guide for Local Governments](#)” for use by local governments across BC (herein referred to as ‘the provincial guide’). The provincial guide contains a comprehensive analysis and recommendations that support this document. Content from the provincial guide is referenced throughout this document, where appropriate and noted.

The City of Richmond also released another recent publication prepared by AES Engineering, Hamilton & Company, C2MP, and the Fraser Basin Council titled “[Electric Vehicle Charging Infrastructure in Shared Parking Areas](#)”. Content from this document is also referenced throughout this document, where appropriate and noted.

## Acronyms

The following acronyms are referenced throughout this document:

- BEV** A Battery Electric Vehicle (“BEV”) is powered exclusively by electricity and must be plugged in to charge. BEVs can be charged via an EV charger or by a typical wall outlet. BEVs can, on average, travel anywhere from 100 to 400 kilometres with a fully charged battery before requiring a charge.
- CRD** The Capital Regional District (“CRD”) is the regional government for 13 municipalities and three electoral areas on southern Vancouver Island and the Gulf Islands, serving more than 392,000 citizens. The CRD provides regional decision-making on issues that transcend municipal boundaries and enables effective service delivery to residents.
- E-Bike** An Electric Bicycle (“E-Bike”) is a type of bicycle with an electric motor of 500 watts or less and functioning pedals that is limited to a top speed of 32 km/h without pedalling.
- EV** An Electric Vehicle (“EV”) is a class of vehicles that runs fully or partially on electricity. EVs have a battery along with (or instead of) a gasoline tank, and an electric motor along with (or instead of) an internal combustion engine.
- EVSE** Electric Vehicle Supply Equipment (“EVSE”) refers to infrastructure installed and used to provide electricity for the purposes of charging an electric vehicle.
- MURB** Multi-unit Residential Building (“MURB”) is comprised of a common entrance and separate units that are also known as apartments constructed for dwelling purposes.
- OCP** An Official Community Plan (“OCP”) is a local government’s core planning document that contains a statement of objectives and policies to guide decisions on planning and land use management.
- PHEV** A Plug-In Hybrid Electric Vehicle (“PHEV”) is fueled with both gasoline and electricity. PHEVs can travel between 20 and 60 kilometres powered by an electric engine and a fully charged battery, and/or 500 to 900 kilometres powered by an internal combustion engine and a full tank of gasoline.
- ZEV** A Zero Emission Vehicle (“ZEV”) is a vehicle that emits no exhaust gas from the onboard source of power. A ZEV is an all-encompassing term that refers to all types of electric vehicles including plug-in hybrids, battery electric vehicles, and hydrogen fuel cell vehicles.

## Terminology

The following terms are referenced throughout this document and may not be widely understood:

- EVEMS** Electric vehicle energy management systems (“EVEMS”) refer to a variety of technologies, including service provision, that allow multiple vehicles to charge on the same circuit. EVEMS are also referred to as “load sharing”, “power sharing”, or “smart charging” systems.
- Garage Orphan** A garage orphan refers to a household that does not have access to a carport or garage, and therefore does not have the ability to charge an EV on-site.
- Range Anxiety** Range anxiety refers to the fear of running out of battery power before the next opportunity is available to charge an electric vehicle.
- Level 1 Charger** A Level 1 charger uses a standard house plug (120V) and can be used for overnight charging at home or all-day charging at work. When charging cars overnight (8–10 hours), Level 1 chargers can fully recharge most PHEVs and “top up” a BEV from a typical work commute.
- Level 2 Charger** A Level 2 charger uses a dedicated 208V or 240V circuit like those used for clothes dryers. Level 2 chargers are generally the preferred option for home charging. Level 2 is also appropriate in public locations where cars generally park for one or more hours, which allows EV owners to top up their charge while shopping, recreating, or working.
- Level 3 (Direct Current Fast Charger)** A Level 3 charger or DCFC can provide about an 80% charge in half an hour. Direct current fast charging is currently (based on today’s technology and costs) not considered suitable for residential installations due to the high cost of equipment, installation, and power requirements. Not all electric vehicles can plug into a DCFC charger.

## 2. Understanding EVs + E-Bikes

### 2.1 What is an Electric Vehicle (“EV”)?

For the purposes of this document, an electric vehicle is considered any vehicle that runs fully or partially on electricity. An EV receives power in whole or in part from an electric motor, depending on the type (e.g., a Battery Electric Vehicle relies completely on the electric battery for energy, whereas a Plug-In Hybrid Electric Vehicle can use either the electric engine or an internal combustion engine to propel the car). Hybrid vehicles are a type of electric vehicle, but cannot be plugged in and charged and are therefore not included in this document.

#### EV Types / Technologies

There are two distinct vehicle types, shown below:



**Battery Electric Vehicles (“BEVs”)** run exclusively on electricity and need to be plugged into an outlet or charging station to recharge the battery. The typical battery range varies from 100 km to over 400 km. Examples of BEVs include Chevrolet Bolt (left), Nissan Leaf, Tesla Model S.



**Plug-In Hybrid Electric Vehicles (“PHEVs”)** have both an electric motor and an internal combustion engine. The electric motor needs to be charged at an outlet or charging station and typically has a shorter battery range than BEVs, and PHEVs use the internal combustion engine when the battery is low or when extra propulsion power is needed. Examples of PHEVs include Hyundai IONIQ (left), Kia Optima, Chevrolet Volt.

## EV Models + Characteristics

As of May 2018 there are 36 existing EV models (11 BEVs and 25 PHEVs) that are available in British Columbia. See the *Backgrounder (page 3)* for a complete list or visit [www.pluginbc.ca](http://www.pluginbc.ca).

**Table 1** presents the extent of characteristics of these BEVs and PHEVs.

**Table 1. Summary of Electric Vehicle Models + Characteristics**

| Type | Vehicle Range*<br>(km)          | Vehicle Cost<br>(CAD\$)                   |
|------|---------------------------------|---|
| BEV  | 155 – 539<br><i>Median: 201</i> | 28,800 – 200,200<br><i>Median: 36,000</i> |
| PHEV | 19 – 85*<br><i>Median: 27</i>   | 31,999 – 152,715<br><i>Median: 56,700</i> |

\*Vehicle range represents electric battery range only.

## 2.2 About EV Charging Stations

There are four types of charging stations: Level 1, Level 2, Level 3 and Tesla Supercharger. **Figure 1** illustrates the key differences between a Level 1, Level 2, and Level 3 charger whereas **Table 2** shows the difference in charging range between Level 2 and Level 3 chargers

**Level 1** charging stations are household outlets which provide 120V of AC power to the vehicle. This type of charging takes the longest time, and is typically a good option overnight.

**Level 2** charging stations provide a higher amount of AC power (240V) to the vehicle. Level 2 charging stations recharge the batteries in about four hours. These stations are the most commonly available public charging stations, and can be installed in parkades, surface lots or even curbside.

**Level 3** charging stations are the quickest-charging stations, in that they provide 480V DC power, and are able to charge a full battery in less than an hour. The charging station is about the size of a fuel pump at a gas station.

**Tesla Supercharger** is a special Level 3 charger that can only be used to charge a Tesla vehicle; other makes of EVs do not currently have access. These stations are owned and operated as part of the Tesla network of superchargers world-wide and are typically sited to support the long distance travel needs of Tesla owners, but increasingly are being installed

within cities to facilitate charging for those living condos and others without access to home charging. Note: Tesla Superchargers are not referenced in this document as they cannot be used by most EV users.

Figure 2. EV Charging Infrastructure Pyramid

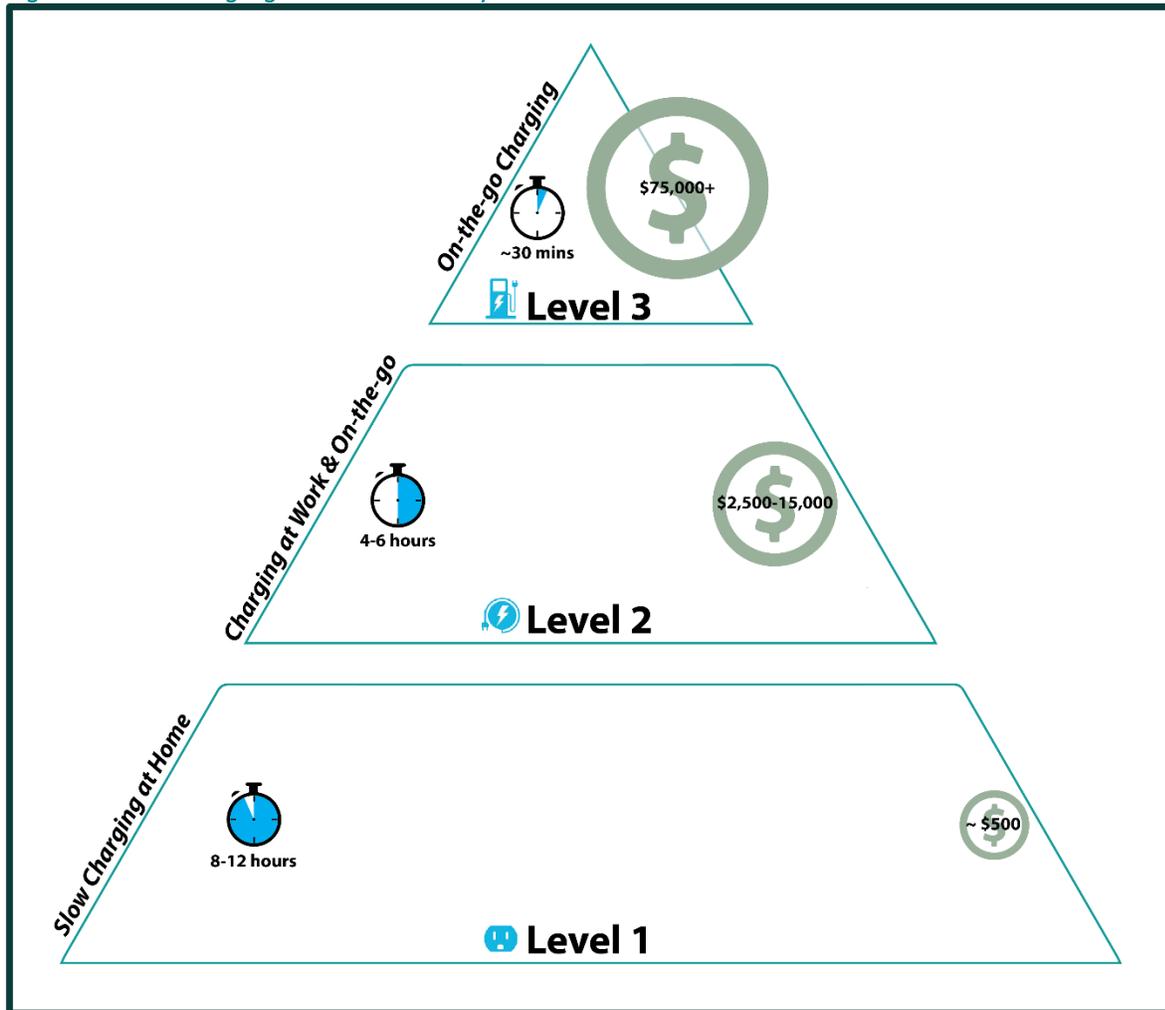


Table 3. EV Charging Range Based on Charging Level<sup>1</sup>

| Vehicle Type                             | Charging Range Per Hour<br>(Level 2 Charger) | Charging Range Per Half Hour<br>(Level 3 Fast Charger) |
|--|--|--|
| BMW i3                                   | 42 km  | 103 km   |
| Chevy Bolt                               | 41 km  | 273 km   |
| Chevy Volt                               | 18 km  | no fast charging                                       |
| Mitsubishi Outlander PHEV                | 12 km  | 28 km  |
| Nissan Leaf (2 <sup>nd</sup> Generation) | 17 km<br><i>(option for 34 km)</i>           | 194 km   |
| Tesla Model S                            | 45 km  | —*   |
| Tesla Model X                            | 43 km  | —*   |
| Tesla Model 3 Long Range                 | 60 km  | —*   |
| Volkswagen e-Golf                        | 21 km<br><i>(option for 41 km)</i>           | 161 km   |

\*Tesla models are typically charged at a Tesla Supercharger station, which provide 321 km for Model S, 306 km for Model X, and 399 km for Model 3 in 40 minutes.

Based on the data above, the percentage increase in terms of charging speed between a Level 2 and Level 3 charger ranges from 133% to 1041%. However, this comes with a trade-off; there is a significant cost difference between a Level 2 and a Level 3 charger. Therefore, it is imperative to consider careful and strategic siting of Level 3 charging stations in select locations that will yield the highest utility (for a detailed discussion about siting considerations for Level 2 and Level 3 charging stations, see the *Backgrounder, Section 5.1*).

According to BC Hydro, about **95 percent of all car trips in the province are less than 30 kilometres**. The approximate charging time for 30 kilometres of range varies from 6-7 hours (Level 1 charger), 1-3 hours (Level 2 charger), and 10 minutes (Level 3 DCFC). For more information see BC Hydro’s report entitled: [Unplugged: Myths to block road to the electric car dream \(April 2018\)](#).

<sup>1</sup> This table has been modified from the provincial guide “Residential Electric Vehicle Charging: A Guide for Local Governments”.

## EV Charging Needs

EV charging needs vary based on location; home charging for example usually includes a Level 1 or 2 charging station as charging typically occurs overnight. EV charging infrastructure requires a comprehensive plan to provide a charging network that will be adequate and convenient to existing EV owners (and to encourage prospective EV owners). A complete charging network comprises chargers at homes, work and other destinations, publicly accessible locations, and along highway corridors. The importance of providing a public network is critical not only for EV owners that want to charge “on the go”, but also for the EV owners that do not have access to charge at home (i.e., “garage orphans” who live in a multi-unit residential building or a home without a driveway or garage). See *Background Section 2.2* for a more detailed discussion on this topic.

Needs and expectations of EV owners have changed over time. Early adopters of EVs were willing to accept challenges; however, current prospective EV owners are less willing to deal with barriers. One key barrier that was identified in the CRD public survey is lack of access to charging at home.

**Table 3** below presents a summary of charging needs for both existing and prospective EV owners based on a 2015 study, which illustrates that many early adopters had access to charging at home”.<sup>2</sup>

**Table 3. EV Charging Needs Based on Charging Level**

| EV owners (BC Sample)  | Prospective EV owners (Canada-wide Sample)   |
|--|--|
| 97% have access to home charging (Level 1)   | 66% have charging access at home (Level 1)   |
| 75% have installed a Level 2 Charging Station  | 19% have access to a Level 2 Charging Station  |
| 86% were aware of at least one public charger  | 33% have seen at least one public charger<br><i>(Higher awareness in BC than rest of Canada)</i>                                 |
| Infrequent use of public chargers (once per month or year). Respondents reported that after a learning period they had little need to use public charging infrastructure | Typical public charger locations that were identified by prospective EV owners in BC:<br>Shopping malls, Retail & Grocery Stores |

### Key Challenges

Understanding the key challenges to EV adoption is critical to determining the most appropriate suite of policies, strategies, and incentives that could be implemented to alleviate barriers and increase EV adoption rates. A detailed summary of the key challenges to EV adoption in the Capital Region are included in the *Backgrounder, Section 6.1* and are summarized below. The barriers identified below are derived from the CRD public survey and the academic literature.

|   |  |
|---|--|
| <b>High Purchase Price</b>                      | EVs are generally \$35,000 or more, owing largely to battery costs. Potential EV buyers may fail to acknowledge the “total cost” of EV ownership compared to gasoline-powered vehicles, which includes no gasoline and limited maintenance. Purchase price was identified as the most significant barrier in the CRD public survey.  |
| <b>Lack of Ability to Charge at Home</b>        | For households that do not have access to a carport or garage, the inability to access on-site charging overnight can be a major problem. Approximately 20 percent of the respondents in the CRD public survey selected “don’t have the ability to charge at home” as a key barrier to EV ownership. This can include residents in a multi-unit residential building who do not have access to charging station or a single-family home / townhouse without a driveway or garage, for example. |
| <b>Availability of Public Charging Stations</b> | Potential EV buyers cite a lack of access to EV charging as a barrier to ownership, which includes lack of access to charging at home (i.e., “garage orphans”) or lack of access away from home (i.e., at work, school, shopping, or public facilities). The CRD public survey also reported this barrier; about 21% of respondents indicated that the lack of public chargers in the region is a barrier to EV ownership.   |
| <b>“Range Anxiety” – Real Vs. Perceived</b>     | Range anxiety refers to the fear of running out of battery power before encountering the next opportunity to charge. Range anxiety has been demonstrated to be much higher among potential EV purchasers as compared to EV owners. Studies   |

have shown that a large gap exists between perceived and real-world range anxiety which can be alleviated by driving experience. Research has also found that as the range of an EV increases, so does the willingness to purchase of vehicle. Range anxiety was reported as a barrier in the CRD public survey.

### **Lack of Familiarity with EV Technology**

Much of the general public has limited understanding of EV technology and its practical benefits, and no prior experience driving or riding in an EV. A 2017 Canadian survey by Plug'N Drive found that more than 40 percent of interviewed EV owners were introduced to EVs by a friend, a relative or a colleague before owning one. Many gasoline-powered car owners had never been exposed to an EV before buying their car.<sup>3</sup>

### **Lack of Variety in Model Types**

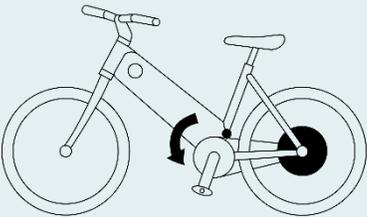
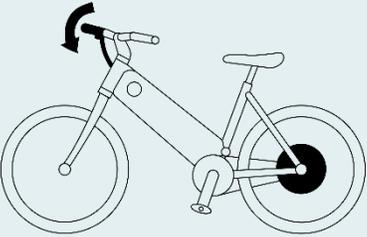
EVs are generally only available in compact or sub-compact models, limiting their appeal to the broad consumer audience. Further, their current popularity has led to dealerships unable to meet demand within a reasonable timeframe. One study<sup>4</sup> indicated that EVs will need to become available in a broader set of vehicle types, or consumers will need to shift their interests in EV vehicle types, if EVs are to achieve high percentages of vehicle purchases.

## 2.3 What is an Electric Bike (“E-Bike”)?

E-Bikes are electric bicycles with an electric motor of 500 watts or less and functioning pedals that is limited to a top speed of 32 km/h without pedalling.<sup>5</sup> The amount of assistance the motor supplies depends on the size of the motor: smaller motors work to only assist the rider’s pedaling and larger, more powerful, motors can propel the bike forward without the rider needing to pedal.

E-Bikes are classified according to their power, and there are three distinct classes, broadly described in [Table 4](#). [Table 5](#) presents an overview of E-Bike performance and costs.

**Table 4. E-Bike Classes**

|   |   |
|---|---|
|   | <p><b>Pedal Assist</b> (also known as “pedelecs”) automatically provide power (or assistance) when the user encounters conditions where increased physical effort is required, which can be beneficial for reducing the physical exertion required for going up steep grades or pedalling against a strong headwind, for example.</p> |
|  | <p><b>Power-On-Demand</b> systems only provide power when initiated by the user using a throttle typically integrated into the handgrip.</p>  |
|   | <p><b>Hybrid</b> systems combine both the automated pedal-assist sensor and the option to manually engage the motor by utilizing the throttle.</p>  |

A discussion of E-Bike charging requirements is summarized in [Section 5.0](#).

Table 5. Summary of Select E-Bikes Available in Canada in 2018, Performance + Cost

| Type                             | Name / Model*                      | Battery Range (km) | Top Speed without Pedaling (km/h) | Cost (CAD\$) |
|----------------------------------|------------------------------------|--------------------|-----------------------------------|--------------|
| Pedal-Assisted / Power-on-demand | Stark Drive City                   | 40                 | 25                                | 399          |
|                                  | Spark                              | 80                 | 32                                | 1,300        |
|                                  | Interceptor   Electric Cruise Bike | -                  | 32                                | 3,800        |
| -                                | OHM-EbikeBC XU450                  | 40-80              | 32                                | 2,500        |
| Pedal-Assisted                   | OPUS Grid                          | 38                 | 32                                | 2,500        |
| Pedal-Assisted with options      | Opus Connect                       | 125                | 32                                | 3,600        |
| -                                | Powerfly 5 Women's                 | -                  | 32                                | 4,600        |

\*Juiced Bikes sells two models (OceanCurrent and CrossCurrent S) that travel at higher top speeds than a typical E-Bike at 38km/h and 45km/h respectively.

### Key Challenges

Similar to EVs, a list of the key challenges to E-Bike adoption is included in the *Backgrounder, Section 6.1*. A summary of the key challenges is provided below:

#### High Purchase Price

Similar to the price barrier identified for EVs, E-Bikes are generally more expensive than regular bikes. The cost differences vary depending on geography; in North America the differences are approximately 25-40%. The CRD public survey found that the cost of E-Bikes was the largest barrier identified by survey respondents.

#### Lack of Secure Parking, Security + Fear of Theft

E-Bikes are more expensive than regular bikes and as such, require secure facilities to prevent theft. In recent studies E-bike owners expressed concern and anxiety about the security of their E-Bike. <sup>6,7</sup>

Concerns about theft are partially explained by lack of secure bike parking. The CRD public survey found that the lack of

secure parking is a barrier facing prospective E-Bike owners. Approximately 27 percent and 15 percent of respondents selected “afraid that it might be stolen” and “lack of places to park an E-Bike”, respectively, as factors for why they have not purchased an E-Bike.

### **General Safety Concerns**

Numerous studies have confirmed the issue of safety as a key barrier to E-Bike adoption and a concern for E-Bike owners. The two primary safety issues are (1) the actual safety of the E-Bike itself including its higher operating speed relative to a regular bicycle and (2) safety of riding an E-Bike on the road. The CRD public survey found that approximately 22 percent of respondents selected “concerned about safety” as barrier to E-Bike ownership. A number of qualitative responses pertained to the need for better cycling infrastructure including protected bike lanes.

### **Social Stigma**

Research has also reported the stigma attached to E-Bikes. Some people perceive E-Bikes as “cheating”, as it takes away the physical effort required to pedal a regular bicycle. E-Bike owners reported being judged by their work colleagues, who deemed an E-Bike as a more suitable form of transportation for those with mobility challenges.<sup>8</sup>

## 2.4 The Larger EV Policy Context

While local governments have specific roles in supporting both EV and E-Bikes (see [Section 2.5](#)), other levels of government and utilities have and continue to be involved in promoting electric vehicles, as well. A brief description is provided outlining the roles of each respective government / utility.

### Federal Government

The Canadian government recently released *Transportation 2030*, which is a strategic plan for the future of transportation in Canada. The plan is guided by five unique themes including “green and innovation transportation”. As part of the government’s commitment to this theme, the 2017 budget dedicated \$120 million for EV and alternative fuelling infrastructure and \$17.2 million for Transport Canada and Environment and Climate Change Canada to develop and implement heavy-duty vehicle retrofit and off-road regulations as well as a clean fuel standard.<sup>9</sup> Both the provision of funding for EV charging stations and clean fuel standards, once developed, are expected to help support and increase EV adoption.

At this time, the federal government has not adopted a specific EV policy; however, recommendations have been made by universities and think-tanks for the government to consider adopting a Zero-Emission Vehicle (ZEV) mandate, which would require auto manufactures to sell a minimum percentage of electric vehicles. For a more detailed description of the ZEV mandate, and other EV policy recommendations, see *Canada’s Electric Vehicle Policy Report Card*, published by SFU’s Sustainable Transportation Action Research Team.<sup>10</sup>

### BC Provincial Government

The BC government’s role in EV promotion has been through the Clean Energy Vehicle Program (CEVP), which is administered through the New Car Dealer Association of BC.<sup>11</sup> The goal of the program is to make clean energy vehicles (i.e., EVs) more affordable for British Columbians. To date, the BC government has committed over \$40 million toward the program, of which \$37 million has been specifically allocated to the CEVforBC vehicle incentive program.<sup>12</sup> This program offers incentives of \$5,000 off the purchase price or lease of a new BEV or PHEV and \$6,000 toward a hydrogen fuel-cell vehicle. In addition to CEVforBC, the CEVP has also dedicated funding to charging infrastructure incentives / investments for both Level 2 and Level (DCFC) stations.

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On November 20<sup>th</sup>, 2018, the BC government announced that it will introduce legislation in 2019 to phase in targets for the sale of zero-emission vehicles (ZEVs). Specifically, the legislation will set targets of 10% ZEV sales by 2025, 30% by 2030, and 100% by 2040.<sup>13</sup> To support these targets, the BC government will commit to the following actions:

- Expand the size of the provincial Level 3 DCFC charging network to 151 sites. There are already 71 completed or underway and with federal government and private-sector funding, another 80 will be implemented.
- Increase the size of the CEVP by allocating another \$20 million to the program in 2018. This will bring the program up to \$57 million in total.
- Review the incentive program and expand over time so buying an electric vehicle becomes more affordable to middle- and lower-income British Columbians.

The BC government has a number of other policies in place that support EV adoption including the provincial carbon tax (\$35 / tonne of CO<sub>2</sub>e) and the renewable and low carbon fuel requirements regulation, among others.

### BC Hydro

BC Hydro has also been involved in supporting EV adoption.<sup>14</sup> Their involvement has been multifaceted and three specific examples are as follows:

- Working with the BC and federal governments to explore opportunities to expand the DC fast charging station network across the province.
- Assessing the DC fast charging market and researching next-generation architecture to keep up with growing and evolving market needs.
- Providing certified electrician recommendations to EV owners looking to install charging infrastructure.

### BC Utilities Commission

The BC Utilities Commission (BCUC) regulates the sale and resale of electricity in BC. Municipalities who sell electricity to its residents are exempt from the BCUC. BCUC is currently undertaking an inquiry to explore the potential regulatory issues and opportunities in the EV charging stations market. The Inquiry's Phase One Report was released on November 26, 2018.

As indicated in the inquiry FAQ, the services, rates, and rate design associated with EV charging are currently in an early development stage in BC. But, with the growing popularity of EVs and increasing availability of public charging stations—currently over 1,000 in the province—there is a need to assess the regulatory needs, or lack thereof, that would “be associated with EV charging service, and can also include the setting of rates for EV charging service and any other matters that are of concern or interest to stakeholders”.<sup>15</sup> More information about the inquiry is found online.<sup>2</sup>

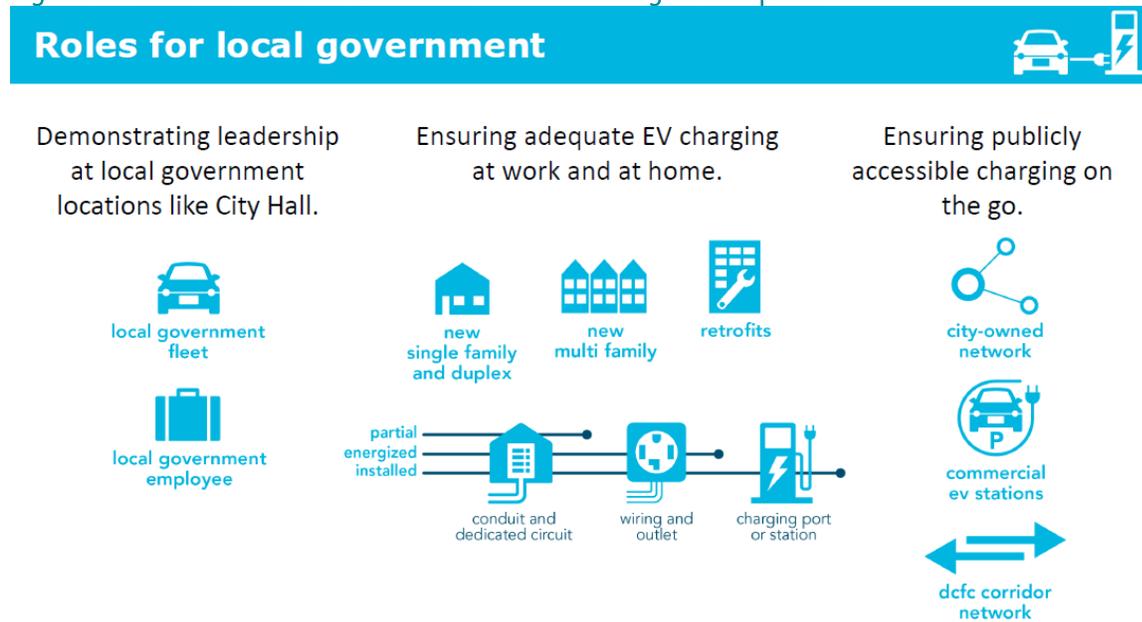
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<sup>2</sup> More information about the BCUC Inquiry is available here: <https://www.bcuc.com/ApplicationView.aspx?ApplicationId=613> and here: [http://www.bcuc.com/Documents/Proceedings/2018/DOC\\_50755\\_02-08-2018\\_BCUC-EV-Charging-FAQ.pdf](http://www.bcuc.com/Documents/Proceedings/2018/DOC_50755_02-08-2018_BCUC-EV-Charging-FAQ.pdf)

## 2.5 Local Government Roles

Local governments are in a unique position to promote and advance emerging mobility options such as EVs and E-Bikes. As shown in the **Figure 2** below, there are at least three ways local governments play a role.

Figure 2. Role for Local Government in Accelerating EV Adoption<sup>3</sup>



While the figure above is more specific to EVs, local governments can accelerate both EVs / E-Bikes in their communities by doing the following:

- **Leadership at Municipal Hall** | Local governments can electrify their fleets by adding EVs or E-Bikes or providing charging access for employees. Over the past few years, a number of municipalities and the Capital Regional District have been gradually transitioning their fleets to electric.
- **Requiring Charging Equipment in New Developments** | Local governments can facilitate opportunities for EV / E-Bike charging in new developments through requirements in zoning or parking bylaws. This can include a requirement for new buildings to be EV-

<sup>3</sup> Image Credit: City of Langley, BC Hydro, C2MP

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ready, the requirement for an EV charging station, and/or access to an electric outlet for E-Bike charging. See [Section 5.2](#) (Local Government Policy Mechanisms) for details.

- **Provision of a Publicly Accessible Charging Network** | Local governments can play a role in the provision and management of publicly accessible EV / E-Bike charging stations, as discussed in detail in [Section 4.0](#) (Public Charging),



### CRD's Zero Emissions Fleet Initiative

The [Zero Emissions Fleet Initiative](#) is 'technology neutral' and is testing multiple zero emissions fleet alternatives including Fuel Cell Electric Vehicles, Battery Electric Vehicles, Plug-in Hybrid Electric Vehicles and E-Bikes to identify zero emissions alternatives that can meet operational requirements in a cost effective manner.

## 3. EVs + E-Bikes in the Capital Region

### 3.1 Uptake in the Capital Region

The *Backgrounder, Section 3.2* reports local EV ownership data using results from the 2017 CRD Origin Destination Household Travel Survey.<sup>16</sup> The summary of vehicles by fuel type identified 255,300 vehicles in the Regional Planning Area with approximately **1,900** (0.7%) being “electric-only”. The data show electric vehicles represent 1% (or less) in almost all municipalities / electoral areas. The only exceptions are North Saanich (2%) and the Salt Spring Island Electoral Area (4%). This represents an increase from the 2011 survey where only 100 electric-only vehicles were reported (less than 0.001%). Nevertheless, the survey does indicate that EV ownership has increased significantly since the 2011 survey.

In addition, as described in the *Backgrounder, Section 3.1*, EV sales across BC have continued to rise. BC saw 1,400 EVs sales in the first quarter of 2018, representing an increase of 58% over the previous year. BC also currently has the highest per capita EV sales across Canada. These trends indicate that EV sales will likely continue to grow, especially as the costs of batteries decline.

### 3.2 Regional EV Charging Network

According to ChargeHub, as of November 2018, there are approximately 120 EV charging stations in the Capital Region, 116 of which are Level 2, and 4 of which are Level 3 (DCFC).<sup>17</sup> Refer to [Figure 3](#). The sites of charging stations vary; however common location sites for municipally / regionally managed stations include:

- **Libraries** | public libraries are generally evenly distributed across a municipality or region’s area where people typically spend anywhere from 30 minutes to 2 hours. For example, a charging station is available at the Juan de Fuca Branch of the Greater Victoria Public Library in Colwood.
- **Municipal Halls** | a number of municipal halls in the Capital Region host a Level 2 charging station including the municipalities of Esquimalt, Oak Bay, Sidney and Central Saanich, Metchosin, Colwood.
- **Major Parks** | parks and open spaces are generally strong candidates for Level 2 charging stations as they are popular destinations for the public and can maximize the visibility – and convenience – of a charging station.

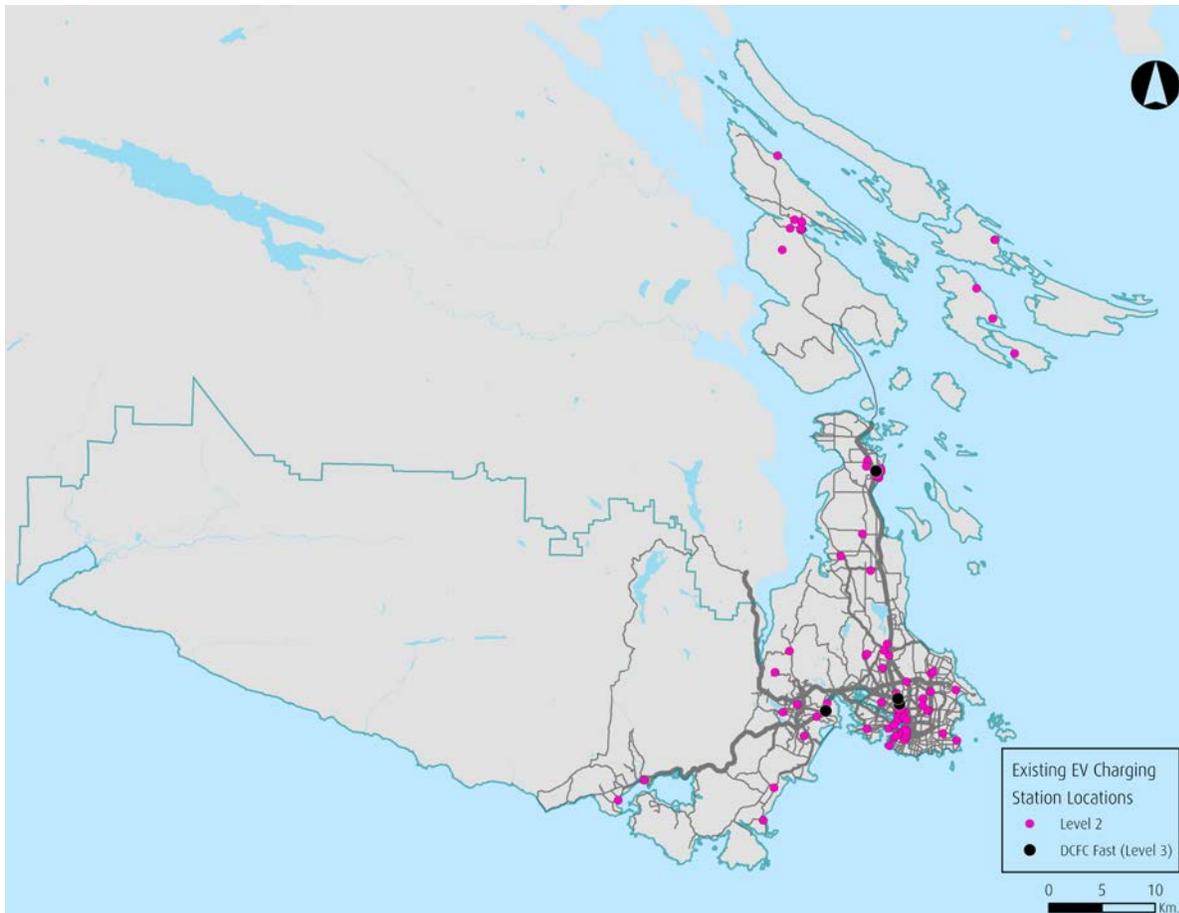
- **Community or Recreation Centres** | they are often evenly distributed across a region's extents, typically one in each municipality where the community gathers for activities, social or sporting events, and/or for public information. They usually contain dedicated parking, which makes them suitable to host a charging station. Charging stations are available at the Pearkes Recreation Centre and Gordon Head Recreation Centre in Saanich, SEAPARC Recreation Centre in Sooke and ArtSpring on Salt Spring Island.
- **Park and Ride Facilities** | park and rides are civic parking locations that connect public transportation systems. Vehicles are typically parked for several hours, making these locations suitable candidates to host a Level 2 charging station. Park and ride facilities can also be used by vehicles parking for a shorter period of time, making them candidates for a Level 3 charging station, as well. Level 2 charging stations are available at the Colwood Park and Ride.
- **Public Parkades** | public parkades serve different trip purposes; commuters may use them for all parking whereas downtown customers may use them for a shorter period of time (i.e., 1-2 hours). Given the variation in dwell times, they are candidate locations for Level 2 charging stations. A total of 8 Level 2 charging stations are available in the City of Victoria's public parkades including three in the Broughton Street Parkade.



### Capital Region Local Governments Support the Public Network

Over the past six years local governments across the Capital Region have installed publicly available Level 2 charging stations at municipally owned buildings including municipal halls, libraries and recreation centres and continue to expand the public charging network.

Figure 3. Locations of Publicly Accessible EV Charging Stations in the Capital Region (as of November 1, 2018)<sup>4</sup>



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<sup>4</sup> New EV charging stations are coming online each year and therefore the map presented in Figure 3 could quickly become outdated. NRCAN maintains an up-to-date database showing EV charging station locations in Canada and could be found online at: <https://www.nrcan.gc.ca/energy/transportation/personal/20487#/find/nearest>

### 3.3 Policies + Regulations in the Capital Region

To understand local policy priorities with respect to EVs and E-Bikes, a review of all thirteen municipalities' Official Community Plans (OCPs) (and equivalent plans in the three electoral areas) was completed. A detailed table is presented in the *Backgrounder, Section 4.0*. It should be noted that OCPs are not updated regularly and EV policy has emerged relatively recently. A summary of the key findings is provided as follows:

- Seven of 13 municipalities in the CRD were found to contain an EV policy in their OCP. A number of communities provide no direction at all (e.g., Central Saanich, Langford, Metchosin, Saanich, and Sidney) whereas other communities have at least one policy including North Saanich, Oak Bay, Victoria, and View Royal.
- Esquimalt and Colwood—two municipalities that recently updated their OCPs—were found to have the most detailed EV policies including specific direction to expand the public charging network along with requiring new developments to be EV-ready and/or provide a charging station.
- The Juan de Fuca electoral area is comprised of seven communities, each of which has an OCP. None of these communities' OCPs were found to have any policy language on EVs or E-Bikes.
- Almost all of the Southern Gulf Islands and the Salt Spring Island electoral areas contain EV policy direction.
- None of the communities within the Capital Region provide policy direction around E-Bikes. This may be due to the fact that E-Bikes are a recent emerging technology and planning policy has not caught up.

As of September 2018, the Town of View Royal is the only municipality in the Capital Region to have a requirement for electric vehicle charging in new developments. The Town's Zoning Regulation Bylaw requires commercial or multiple unit residential developments with more than 100 parking spaces to have access to an electric vehicle charging station on the lot, in a location which is accessible to the patrons or residents.<sup>18</sup>

## 4. Public Charging

### 4.1 Objectives of a Public EV Charging Network

Research has shown that the presence of a public EV charging network is a critical consideration for potential EV buyers. In cities such as Montreal, for example, many EV owners who live in the core part of the city do not have access to a home charging station. As such, the City has strategically sited 400 of its 475 public charging stations on-street to provide viable charging opportunities for households that do not have access to a carport or garage, and therefore do not have the ability to charge an EV. It was reported that having access to a public charging network in Montreal has been valuable for increasing EV uptake among prospective EV owners.<sup>19</sup>

The location of public EV charging stations (i.e., where the stations are physically sited) can influence the personal travel patterns of those electric vehicle users, including the specific travel routes they take and where they shop.<sup>20</sup> Results from the CRD public survey (see *Backgrounder, Section 8.1*) also confirm the importance of a public charging station network. A majority of the respondents identified the need for more public charging stations.

The objectives of a public charging network are three-fold:

1. **Reducing Range Anxiety:** To help alleviate range anxiety by providing drivers with the opportunity for “lifeline” charging, which refers to the ability to charge a vehicle when its battery is almost depleted;
2. **Increasing the EV Profile:** To create public awareness and understanding of electric vehicles and increase exposure and knowledge of EV technology; and
3. **Accommodating Garage Orphans:** To provide viable charging opportunities for households who do not have access to off-street parking (colloquially known as “garage orphans”).
4. **Equity:** To support equitable access to EV charging infrastructure irrespective of income / housing type.

These objectives form the basis of the recommendations outlined in this section.

## 4.2 Regional EV Charging Network Gaps

The outlined regional EV charging network is the result of the infrastructure gap analysis. The purpose of the infrastructure gap analysis was to evaluate where EV charging stations gaps exist in the Capital Region, and to identify the highest priority locations for new charging stations to guide future site selection. The infrastructure gap analysis estimated EV charging station suitability using a Geographic Information System (GIS) by quantitatively assessing individual built environment and transportation criteria that approximate demand for EV charging. The methodology and results of the infrastructure gap analysis are described in detail in the *Backgrounder, Section 7.2*.

The four criteria included in the infrastructure gap analysis were selected based on a review of the academic literature, as follows:

- **Residential Density** | Number of multi-unit residential dwelling units divided by residential land area (square feet).
- **Commercial Density** | Commercial building floor area (square feet) divided by commercial land area (square feet).
- **Land Use Mix** | Evenness of building floor area distribution across multi-unit residential, commercial, and office uses.
- **Traffic Exposure** | Estimated average daily traffic (ADT).

The following tables ([Table 6](#) and [Table 7](#)) identify recommended priority locations for future EV charging stations including both Level 2 and Level 3 (DCFC) stations. Priority locations do not include on-street charging stations but a detailed discuss of on-street charging station considerations is provided in [Section 4.4](#). The recommended priority locations are organized into three distinct geographic areas, as presented below.

1. **Core Area**, which includes the City of Victoria, District of Saanich, District of Oak Bay, Township of Esquimalt, and Town of View Royal;
2. **West Shore**, which includes the City of Colwood, City of Langford, District of Metchosin, District of Highlands, and District of Sooke; and
3. **Peninsula**, which includes the District of Central Saanich, District of North Saanich, and Town of Sidney.

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The infrastructure gap analysis did not include the Southern Gulf Islands, Juan de Fuca Electoral Area, and Salt Spring Island as they scored very low on the built environment and transportation criteria. This was due to the use of normalized data for the entire Capital Region when creating the composite suitability index. In particular, multi-family residential land uses are limited to non-existent for these geographies. For this reason, the outputs of the geospatial analysis did not produce meaningful results to inform decision-making as only a handful of the 200x200 metre cells had registered values. Other considerations when siting public stations relevant to these locations are described below (see 'Other Siting Considerations').

The tables also include “**opportunity sites**”, which are defined as locations that are typically under municipal control including public parks, libraries, recreation centres, parkades, park and rides, on-street (i.e., curbside locations), etc. Opportunity sites have been identified as priority locations, where appropriate, to help inform the municipality where they could site new charging stations. In some priority locations there were no opportunity sites identified due to the absence of public amenities in these areas; in these instances, consideration will need to be given to siting the charging station on non-municipally owned property.

**It should also be noted that further technical study would need to be undertaken to determine whether the location has the electrical capacity to host a charging station.**

Table 6. Recommended Locations for New Public EV Charging Stations, Level 2

| Priority   | Location              | Municipality    | Sub-Area  | Opportunity Sites   | Rationale   |
|--|-----------------------|-----------------|-----------|---|---|
| See Figures 4, 5 and 6 below for the recommended priority locations based on the gap analysis modelling results. |                       |                 |           |   |   |
| 1.   | Cordova Bay           | Saanich         | Core Area | <ul style="list-style-type: none"> <li>Non-municipal opportunity site required</li> </ul> | <ul style="list-style-type: none"> <li>Cordova Bay currently has no EV charging stations but has both the residential and commercial density to make this location suitable for a charging station(s).</li> </ul>   |
| 2.   | Esquimalt Town Centre | Esquimalt       | Core Area | <ul style="list-style-type: none"> <li>Esquimalt Recreation Centre</li> </ul>             | <ul style="list-style-type: none"> <li>According to the Township, the existing charging station at this location has moderate utilization. An additional charging station would be beneficial in the near future to support the high residential / commercial density and the new Esquimalt Town Centre.</li> </ul> |
| 3.   | Stadacona Village     | Victoria        | Core Area | <ul style="list-style-type: none"> <li>Stadacona Park</li> </ul>                          | <ul style="list-style-type: none"> <li>There are currently no EV charging stations in the area and there is a high density of MURBs.</li> </ul>   |
| 4.   | Cook Street Village   | Victoria        | Core Area | <ul style="list-style-type: none"> <li>Beacon Hill Park</li> </ul>                        | <ul style="list-style-type: none"> <li>There are currently no charging stations in Cook Street Village. The village scores high in land use mix.</li> </ul>   |
| 5.   | Admiral's Walk        | View Royal      | Core Area | <ul style="list-style-type: none"> <li>Non-municipal opportunity site required</li> </ul> | <ul style="list-style-type: none"> <li>There are currently no charging stations in or around Admiral's Walk and the area has high commercial density.</li> </ul>  |
| 6.   | Strawberry Vale       | Saanich         | Core Area | <ul style="list-style-type: none"> <li>Rosedale Park</li> </ul>                           | <ul style="list-style-type: none"> <li>There are currently no EV charging stations in this high residential density area.</li> </ul>  |
| 7.   | Keating               | Central Saanich | Peninsula | <ul style="list-style-type: none"> <li>Non-municipal opportunity site required</li> </ul> | <ul style="list-style-type: none"> <li>There are currently no EV charging stations in this area, which has moderate residential density.</li> </ul>   |

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| Priority Location |                       | Municipality    | Sub-Area                | Opportunity Sites  | Rationale  |
|-------------------|-----------------------|-----------------|-------------------------|--|--|
| 8.                | Brentwood Bay         | Central Saanich | Peninsula               | <ul style="list-style-type: none"> <li>Greater Victoria Public Library - Central Saanich Branch</li> </ul> | <ul style="list-style-type: none"> <li>There is one existing charging station and the location has moderate residential / commercial density.</li> </ul>   |
| 9.                | Six Mile Pub          | View Royal      | West Shore <sup>5</sup> | <ul style="list-style-type: none"> <li>CRD Integrated Water Services</li> </ul>                            | <ul style="list-style-type: none"> <li>There are currently no EV charging stations in this high residential density area.</li> </ul>   |
| 10.               | Goldstream Village    | Langford        | West Shore              | <ul style="list-style-type: none"> <li>City of Langford City Hall</li> </ul>                               | <ul style="list-style-type: none"> <li>There is one existing charging station in the area. The area has high residential / commercial density and the right land use mix.</li> </ul>   |
| 11.               | Westshore Town Centre | Langford        | West Shore              | <ul style="list-style-type: none"> <li>Non-municipal opportunity site required</li> </ul>                  | <ul style="list-style-type: none"> <li>There are currently no EV charging stations in the area; commercial density (i.e., shopping centre) is high.</li> </ul>   |
| 12.               | Saseenos              | Sooke           | West Shore              | <ul style="list-style-type: none"> <li>Sooke Library (new)</li> </ul>                                      | <ul style="list-style-type: none"> <li>There are currently no EV charging stations in Saseenos, which has moderate residential density and limited commercial amenities. As such, consideration should be given to a location in Sooke town core.</li> </ul> |

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<sup>5</sup> Note, this priority location is geographically located in the Town of View Royal and is therefore in the “Core Area”. However, for the cartographical purposes, it is shown in the West Shore map given its location on the western boundary of View Royal and its proximity to Colwood.

Figure 4. Recommended Priority Locations for Level 2 Charging Stations, Core Area

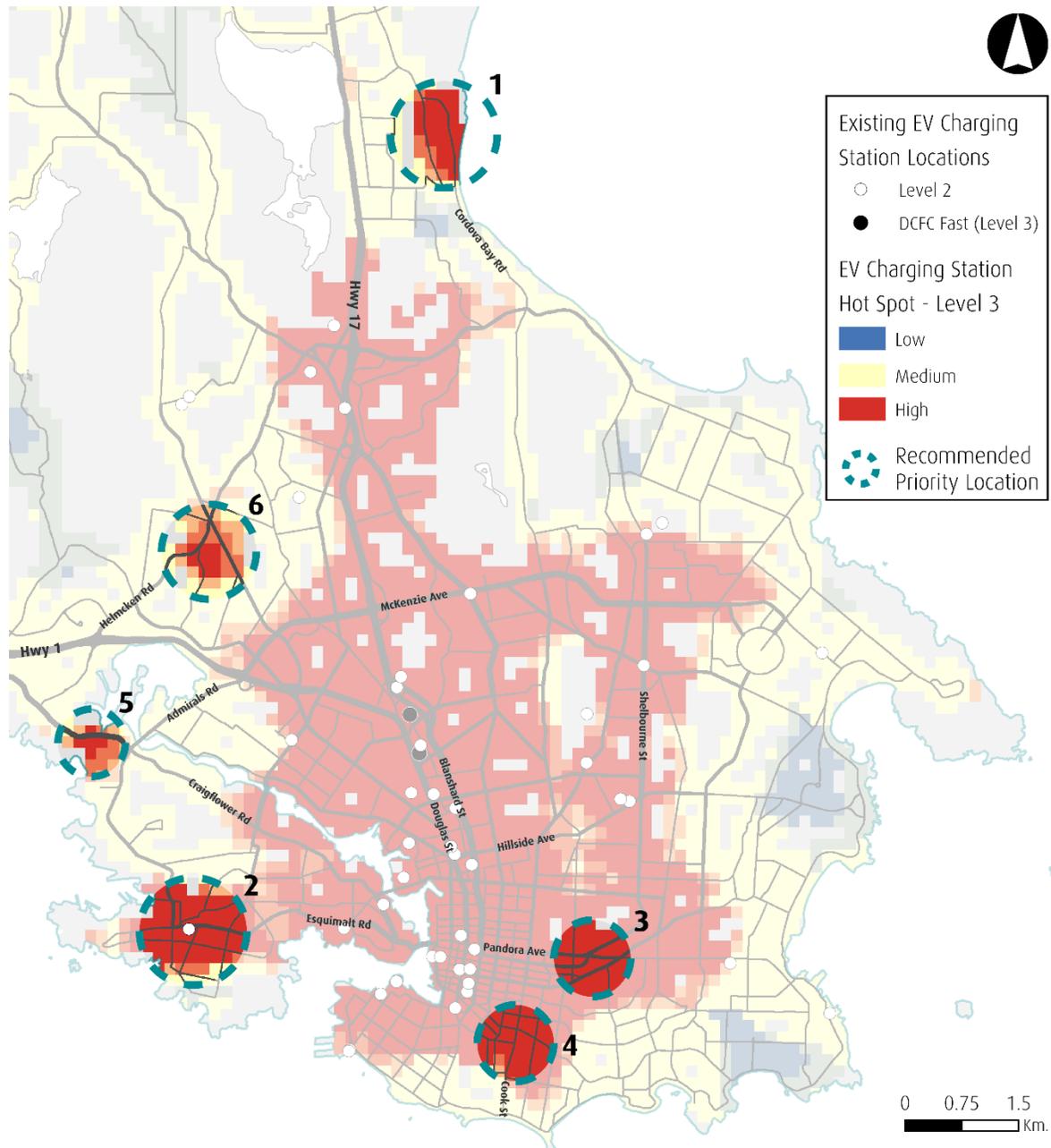


Figure 5. Recommended Priority Locations for Level 2 Charging Stations, Peninsula

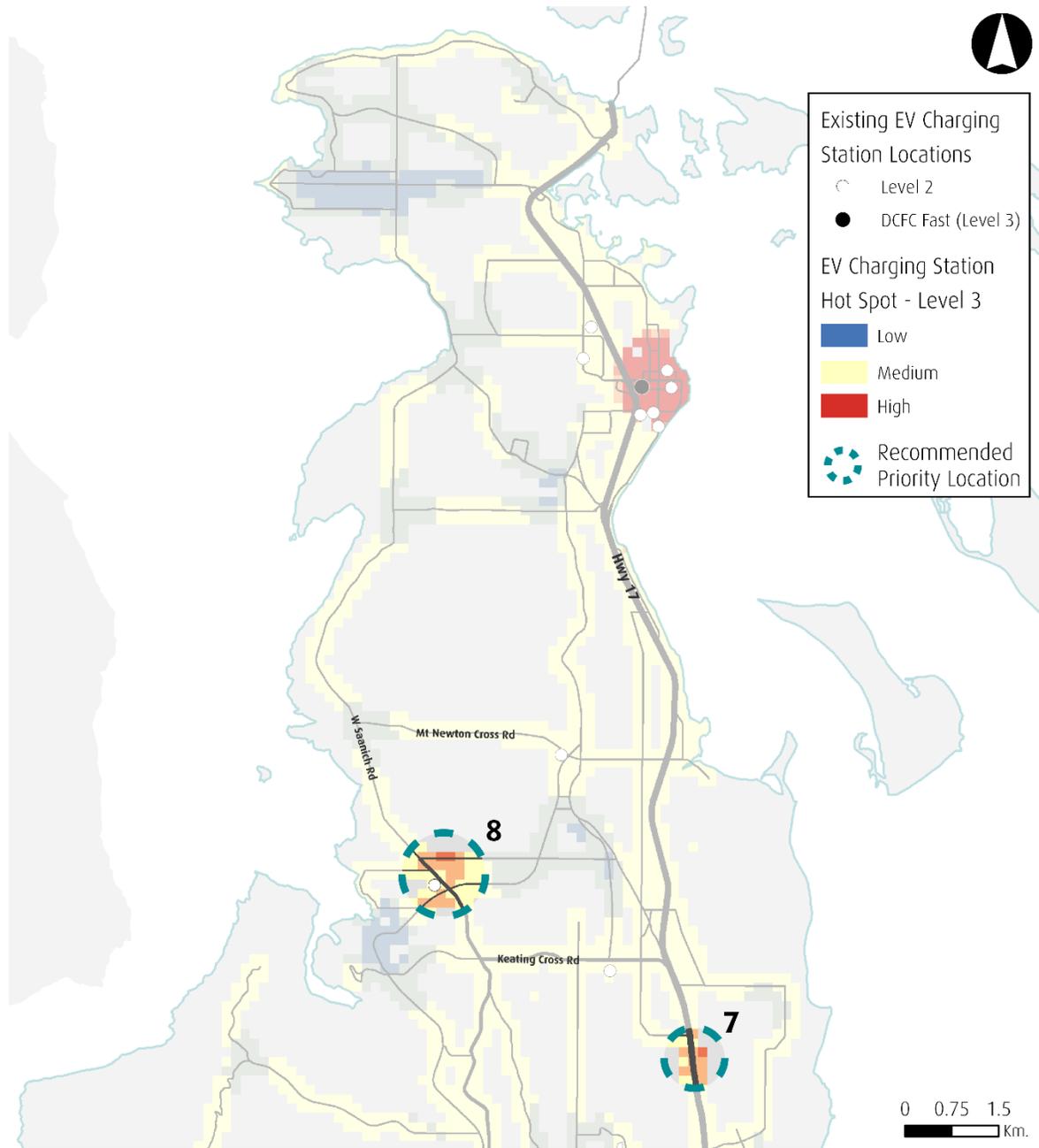


Figure 6. Recommended Priority Locations for Level 2 Charging Stations, West Shore

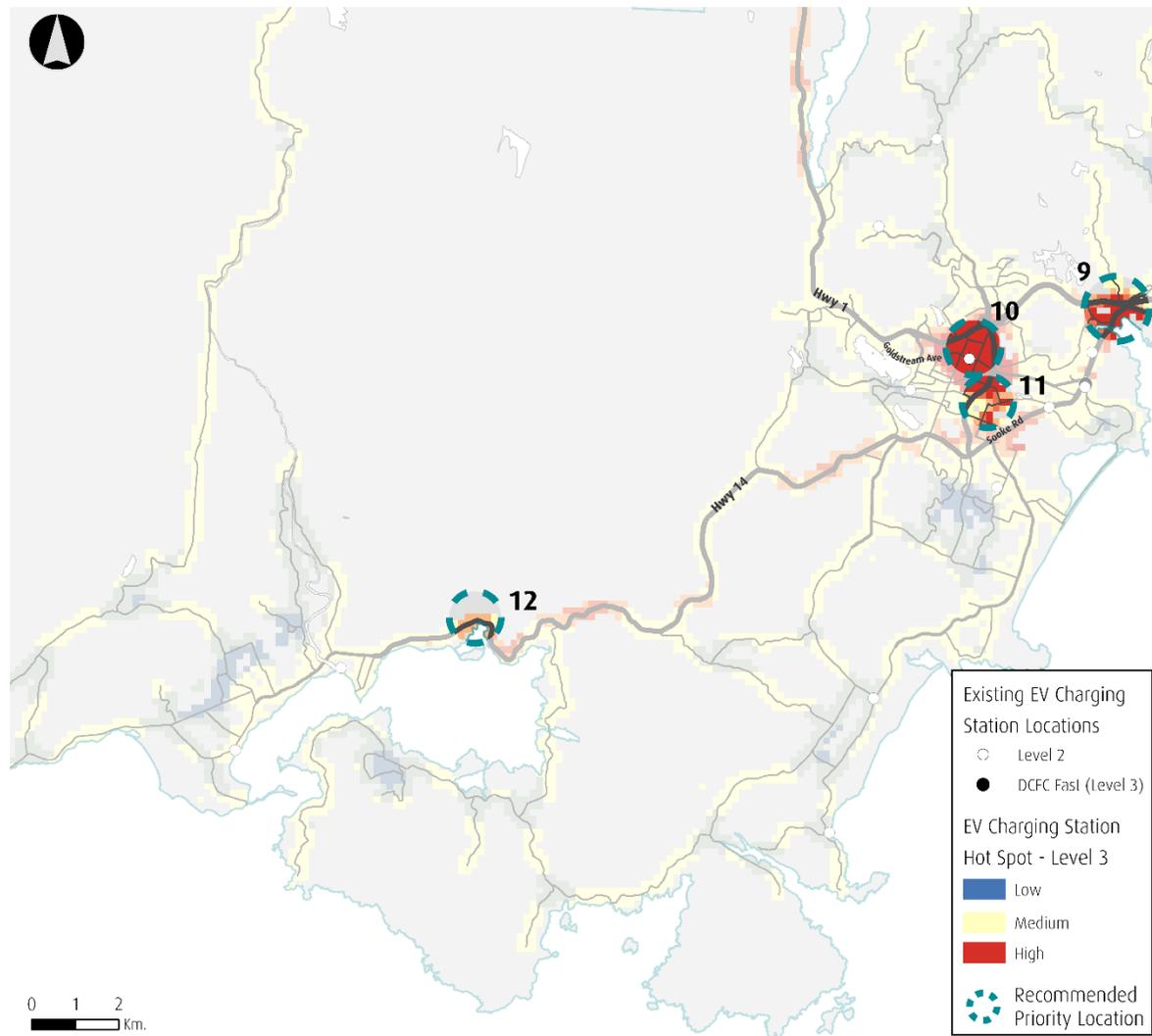


Table 7. Recommended Locations for New Public EV Charging Stations, Level 3 (DCFC)

| Priority Location  | Municipality                    | Sub-Area      | Opportunity Sites | Rationale   |   |
|--|---------------------------------|---------------|-------------------|---|---|
| See Figures 7, 8 and 9 below for the recommended priority locations based on gap analysis modelling results. |                                 |               |                   |   |   |
| 1.   | Broadmead Village               | Saanich       | Core Area         | <ul style="list-style-type: none"> <li>Greater Victoria Public Library - Bruce Hutchison Branch</li> </ul>  | <ul style="list-style-type: none"> <li>The combination of its proximity to Highway 17 (commuting route), commercial density and land use mix make this location suitable for a DCFC.</li> </ul> |
| 2.   | Elk / Beaver Lake Regional Park | Saanich       | Core Area         | <ul style="list-style-type: none"> <li>Elk / Beaver Lake Regional Park - Eagle Beach Parking Lot</li> </ul> | <ul style="list-style-type: none"> <li>Located along Highway 17 (commuting route) and popular destination for residents and visitors alike.</li> </ul>  |
| 3.   | Town of View Royal Town Hall    | View Royal    | Core Area         | <ul style="list-style-type: none"> <li>Town of View Royal Town Hall</li> </ul>                              | <ul style="list-style-type: none"> <li>Located along Old Island Highway (commuting route), and would be under direct control of Town of View Royal.</li> </ul>                                  |
| 4.   | Helmcken Park and Ride          | View Royal    | Core Area         | <ul style="list-style-type: none"> <li>Helmcken Park and Ride</li> </ul>                                    | <ul style="list-style-type: none"> <li>Located along Highway 1 (commuting route).</li> </ul>  |
| 5.   | McTavish Exchange               | North Saanich | Peninsula         | <ul style="list-style-type: none"> <li>McTavish Park &amp; Ride</li> </ul>                                  | <ul style="list-style-type: none"> <li>Located along Highway 17 (commuting route).</li> </ul>   |
| 6.   | Swartz Bay                      | North Saanich | Peninsula         | <ul style="list-style-type: none"> <li>Non-municipal opportunity site required</li> </ul>                   | <ul style="list-style-type: none"> <li>High volume of traffic entering / exiting Swartz Bay; EV users could charge their vehicle while waiting to board ferry.</li> </ul>                       |
| 7.   | Westshore Town Centre           | Langford      | West Shore        | <ul style="list-style-type: none"> <li>Non-municipal opportunity site required</li> </ul>                   | <ul style="list-style-type: none"> <li>Located along commuting route with high commercial density.</li> </ul>   |
| 8.   | Highway 14                      | Sooke         | West Shore        | <ul style="list-style-type: none"> <li>Seaparc Leisure Complex or Sooke Library (new)</li> </ul>            | <ul style="list-style-type: none"> <li>Located along commuting route in proximity to downtown Sooke.</li> </ul>   |

Figure 7. Recommended Priority Locations for Level 3 Charging Stations, Core Area

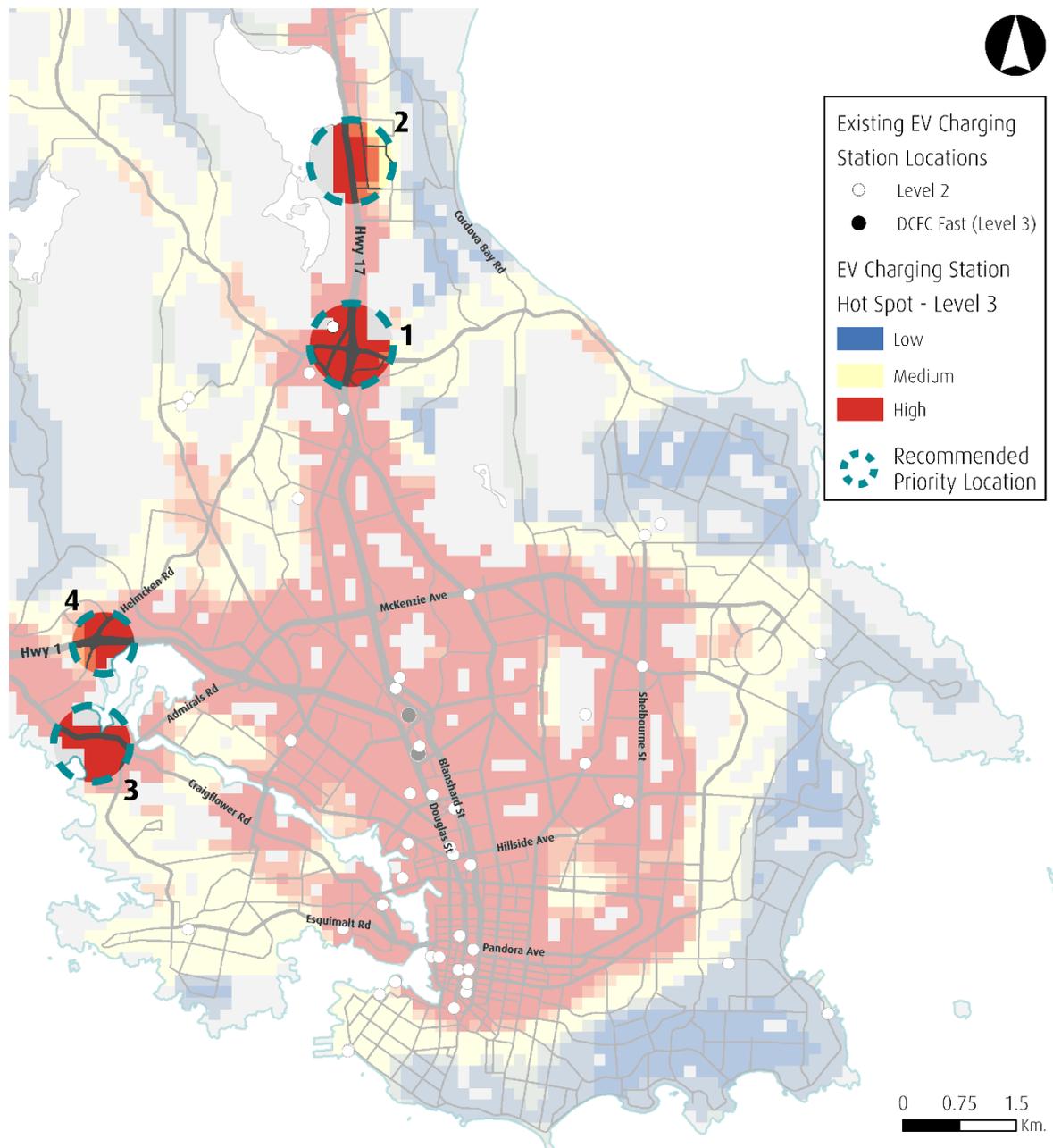


Figure 8. Recommended Priority Locations for Level 3 Charging Stations, Peninsula

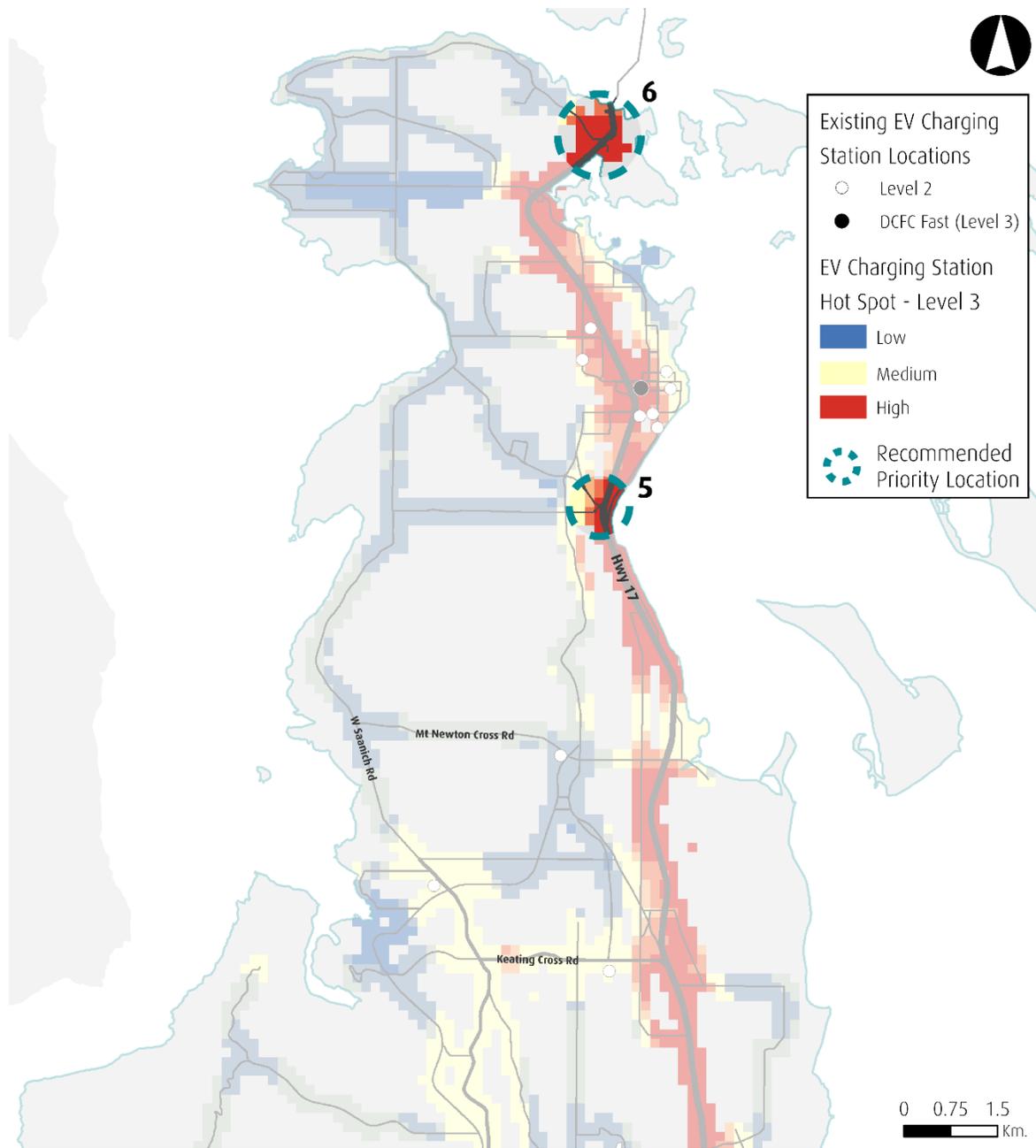
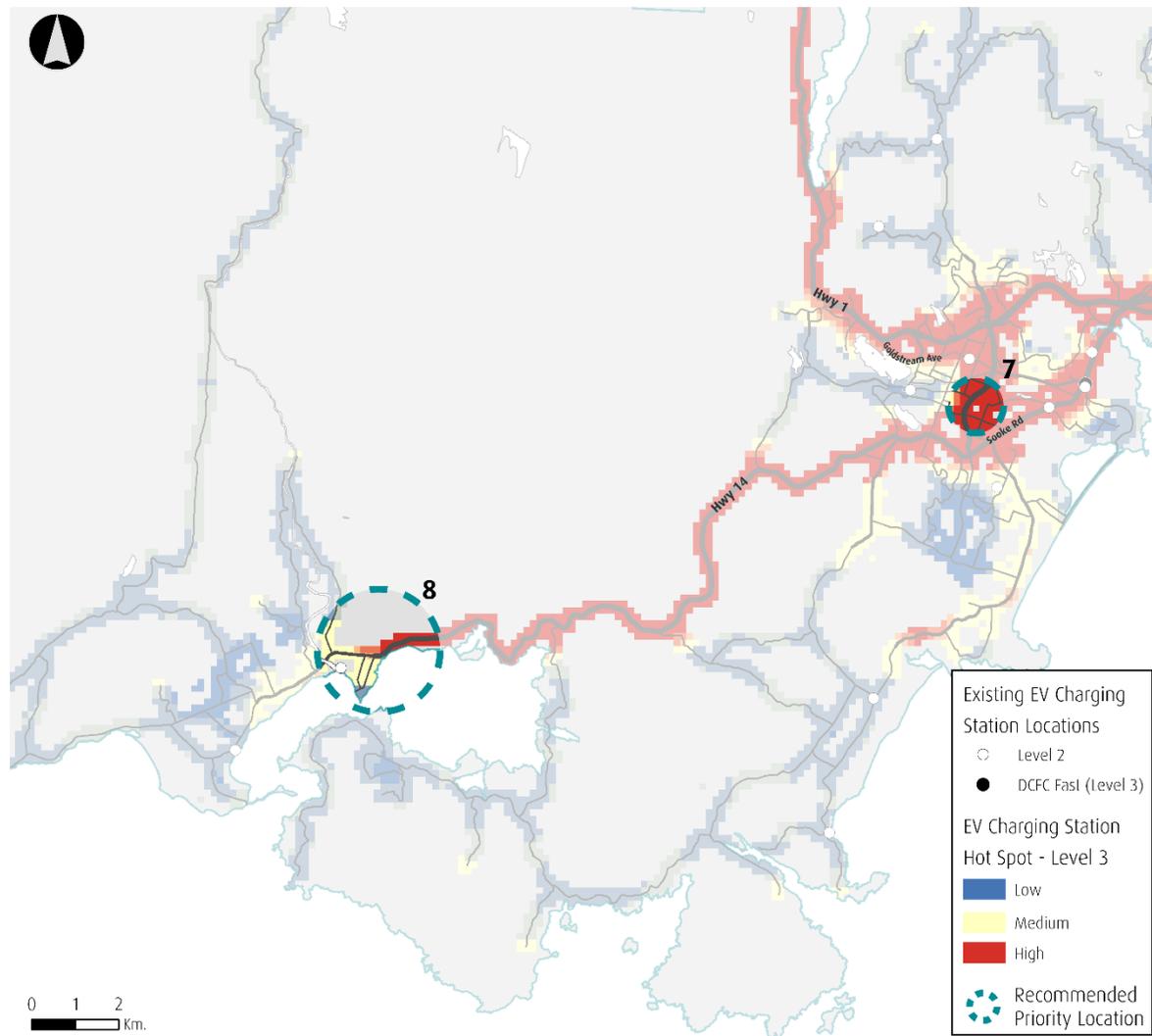


Figure 9. Recommended Priority Locations for Level 3 Charging Stations, West Shore



### Other Siting Considerations

The recommended priority locations shown in the tables above are based on quantitative and measurable criteria that were included as part of the infrastructure gap analysis. While the criteria are comprehensive, there are other qualitative criteria and technical considerations that municipalities / electoral areas should be mindful of when siting an EV charging station, as follows:

- **Rural Commuting Routes** | Even though rural areas in the Capital Region have comparably lower residential / commercial density and land use mix, they should not be overlooked for EV charging stations. In particular, highways and arterials with higher traffic volumes in more rural areas including Sooke, Metchosin, North Saanich, and Central Saanich, Juan de Fuca, Southern Gulf Islands and Salt Spring Island should be considered for public charging infrastructure.
- **Tourism Attractions** | Tourism attractions are places with a high public presence putting pressure on the existing EV networks from visitors.
- **Electrical Capacity & Accessibility** | For Level 3 DCFCs in particular, they require large amounts of electrical current and may result in utility upgrades and dedicated circuits. There are important technical considerations including [a] whether the location has sufficient area for the charging equipment and universal access; [b] whether it has accessible power supply at a reasonable cost; and [c] whether the location is accessible to traffic from all directions.<sup>21</sup>
- **Clusters of Older Multi-Unit Residential Buildings** | Current or prospective owners may not have access to charging and a limited ability to retrofit. Public EV charging equipment may support these garage orphans. See [Section 4.4](#) for a summary of On-Street EV Charging Considerations.
- **EV Charging Banks** | Some cities such as Portland, Oregon, have sited multiple charging stations in one location (referred to as “charging banks”). Known as “Electric Avenue” located in the core part of Portland, EV users can access four Level 3 DCFC charging stations and two Level 2 charging stations.<sup>22</sup>

Experts<sup>23</sup> have recommended charging banks such as Electric Avenue for a variety of reasons including [a] additional options for charging in case one charging station is not operational; [b] less queuing / congestion anxiety, which can reduce the wait time for a user who has access to multiple stations; EV charging station usage data from California

and Oregon showed that EV users avoided single station locations for risk that the station would be in use or not operational; and [c] as EV uptake continues to grow rapidly, investing in more charging stations per location will provide some future-proofing.

- **Pedestrian Traffic** | High pedestrian traffic areas offer both visibility to charging stations and potential mobility challenges. EV charging equipment should not interfere with pedestrian routes; the charging stations should not be placed in an area that would cause a cord to be a tripping hazard.<sup>24</sup> Charging station site choices should consider building entry ways, pathways, street crossings and meeting points that do not impede pedestrians.
- **Future Proofing Opportunities** | As EV ownership increases, local governments may want to increase the number of charging stations at each site. Significant resources can be saved by considering access and future electrical capacity when determining an initial site. Pre-emptive civil and electrical works can be done during an initial install that would accommodate additional charging stations at a lower cost in the future.

### 4.3 EV Charging Station Signs and Directional Markings

The following section identifies the recommended design and application of EV charging directional signs, identification signs and paint markings to ensure consistency throughout the Capital Region and improve recognition among EV drivers with varying levels of familiarity. Installing signage is critical to support EV adoption in the near future. Over time, signage may not be as necessary as technology improves such as mobile apps and in-dash GPS navigation systems becoming more advanced to help EV users locate a charging station.

#### Directional Signs

Directional signs are installed on public roads to provide guidance to EV drivers on the location and distance to public EV charging stations. Recommended directional signs are identified in [Table 8](#).

**Table 8. Recommended EV Charging Station Directional Signs**

|   | Name  | Intent / Application   | Size                              | Reference                        |
|---|---|--|-----------------------------------|----------------------------------|
|   | <b>A1. EV Charge Station Information Sign</b> | The primary EV charging directional sign that, in combination with arrow and distance tabs signs (below), directs EV drivers to the location of EV charging stations.              | 600mm (W), 600mm (H) <sup>1</sup> | MoTI, Sign Series Zi-128         |
|  | <b>A2. Level 3 Charging Tab Sign</b>          | Supplemental sign positioned below an Information Sign (above) where directional or distance information is directing EV drivers to a Level 3 (“fast charge”) EV charging station. |                                   | MoTI, Sign Series Zi-128-Tc      |
|  | <b>A3. Arrow Tab Sign<sup>2</sup></b>         | Supplemental sign positioned below an Information Sign (above) to identify a change in direction required to access EV charging (sign may be rotated).                             | 600mm (W), 300mm (H) <sup>1</sup> | MoTI, Sign Series Zi-128-T (set) |
|  | <b>A4. Distance Tab Sign<sup>2</sup></b>      | Supplemental sign positioned below an Information Sign (above) to indicate the distance to EV charging. Distance may be expressed in metres (m) or kilometres (km).                |                                   |                                  |

**Notes:**

<sup>1</sup> Larger signs required where the posted speed limit exceeds 50 km/h.

<sup>2</sup> Sample tab signs are 2 of 16 Ministry of Transportation and Infrastructure standard tab signs to accompany the EV Charge Station Information Sign (above). Refer to MoTI Electric Vehicle Signage Package, Sign Series Zi-128-T for a full listing of arrow and distance tab signs.

## Identification Signs

Identification signs are installed adjacent to assigned EV parking stalls. They confirm for EV drivers that identified parking stalls are for EV parking, and to non-EV drivers that they may not park in identified EV parking stalls. [Table 9](#) presents different EV charging station signs; the cells shaded in dark grey are recommended for universal adoption in the Capital Region.

Table 9. EV Charging Station Identification Signs (recommended are shaded grey)

|   | Name  | Intent / Application   | Size                    | Reference                          |
|---|---|--|-------------------------|------------------------------------|
|    | B1.<br>EV Charge Station ID + No Parking Sign         | The identification sign to be placed at the end of a parking space adjacent an EV charging station identifying the space for EVs and prohibiting parking by non-EVs. This sign should not be installed in combination with the B2 or B3 signs (below).                             | 300mm (W),<br>450mm (H) | MoTI,<br>Sign Series<br>Zi-129-LRD |
|   | B2.<br>EV Charge Station ID Sign                      | The identification sign to be placed at the end of a parking space adjacent an EV charging station intended to be occupied by EVs. This sign should be installed in combination with the B3 sign (below) to prohibit non-EV parking.   |                         | MoTI,<br>Sign Series<br>Zi-132-1   |
|  | B3.<br>EV Charge Station No Parking EV Exception Sign | The regulatory sign to be placed at the end of a parking space adjacent an EV charging station that is intended to be occupied by EVs and prohibits parking by non-EVs. This sign should be installed in combination with the B2 sign (above) to identify the space to EV drivers. |                         | MoTI,<br>Sign Series<br>Zi-131     |
|  | B4.<br>EV Charge Station Time Limit Sign              | This sign indicates the maximum allowable stay in an assigned EV parking space. This sign should be used in combination with either B1 (above) or B2 and B3 (above).   |                         | MoTI,<br>Sign Series<br>Zi-130     |

Of the EV charging station identification signs shown above, it is recommended that local governments use “B1” (i.e., “No parking except EV Charging”). This sign has been recommended in other best practices documents because of its clear language; specifically, the term “charging” [a] helps eliminate confusion for drivers of hybrid electric vehicles (who are not permitted to park in these stalls except while charging) and [b] indicates that the stall should only be used for EVs that require a charge.<sup>25</sup>

The EV charge station time limit sign (i.e., “B4”) should accompany this sign as it indicates a time limit for how long an EV user could charge their vehicle for. Time limited signage is especially valuable for Level 2 charging stations where a vehicle may be inclined to park for several hours. While the time limited signage may encourage turnover, it also requires regulatory enforcement, which requires staff resources and time.



Example of EV signage at the Gordon Head Recreation Centre in the District of Saanich.

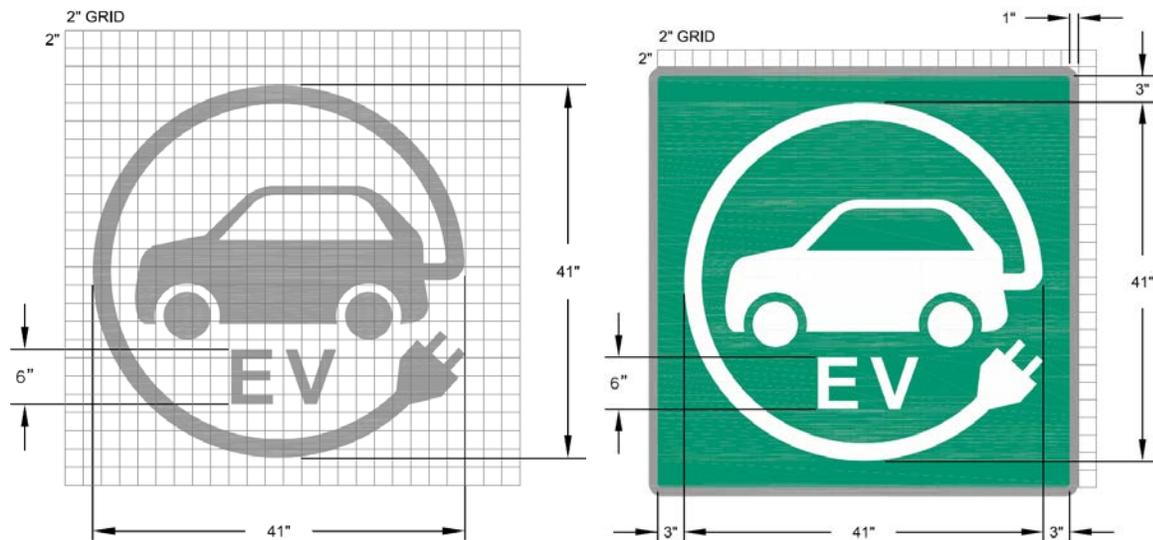
### Pavement Marking

The standard pavement marking used to demarcate EV parking stalls is a vehicle encircled by an electric cord / plug with “EV” indicated below the vehicle. All paint markings are white.

An enhanced treatment consisting of a green background and bounding box may be applied to address concerns with compliance among non-EV drivers or for improved exposure. Refer to

[Figure 10.](#)

Figure 10. Recommended EV Parking Space Pavement Marking, Basic (left), Enhanced (right)



#### Recommended Marking of Green Parking Stalls

The photo shown to the left is the recommended EV parking stall marking.

The entirety of EV parking stalls have been painted green in certain locations in the Capital Region. This treatment is not recommended due to higher capital costs, the need for on-going maintenance, and the potential slipping hazard in wet conditions. The photo shown to the left is the recommended EV parking space marking.

## 4.4 On-Street EV Charging Considerations

The provision of on-street charging (also referred to as “curbside charging stations”) is particularly valuable in meeting the needs of “garage orphans”, which refers to households that do not have access to a carport or garage, and therefore would not have the ability to charge an EV on-site at home. This issue has been recognized by a handful of cities in North America who see on-street charging stations as one potential solution to accommodate garage orphans. These cities include, but are not limited to, Vancouver, Seattle, Toronto, and Montreal—all of which have programs and/or pilot projects currently in place to make on-street charging a viable option for residents.

The following is a list of on-street EV charging considerations of which local governments should be mindful:

1. **Signage & Wayfinding** | As discussed in [Section 4.3](#), signage and wayfinding is critical for both finding and designating EV charging stalls in public areas. Consideration should be given to the signage and wayfinding options described previously. More importantly though, on-street charging must include signage indicating a time limit and may require enforcement if users do not have to pay for electricity.



### On-Street Charging in Montreal

The City of Montreal has the most advanced on-street charging station network of any Canadian city. Many EV owners who live in the core part of the city do not have access to a home charging station. As such, the city has strategically sited 400 of its 475 public charging stations on-street to provide viable charging opportunities for garage orphans. The City is hoping to have 600 on-street charging station by the end of 2018.

2. **Electrical Capacity** | Placement of on-street charging must consider the available electric capacity. This can include the presence of electrical or street light poles placed between

the back of curb and sidewalk. In addition, evaluating the existing electrical capacity can include [a] the electrical system at the location of the desired installation and [b] the capacity of the local neighbourhood system to support multiple EVs charging simultaneously.<sup>26</sup>

- 3. Placement of On-Street Charging Stations** | Placement of an on-street charging station needs to be integrated with other elements in the public right-of-way. As an example of factors to consider, the City of Vancouver's Curbside Electric Vehicle Pilot program has strict placement criteria, which include [a] it can only be installed where there is a curb in the utility/planting strip; [b] minimize removal of vegetation; and [c] preserve as much sidewalk width (path of travel) as possible, but yielding no less than 1.5m – if there is no utility/planting strip
- 4. Obtaining Local Business Support** | Businesses in proximity or adjacent to a proposed on-street charging station should be consulted. Such businesses may perceive they would be negatively impacted, but they also may benefit from having their EV-using clients and patrons access the parking spots. Their support is important to managing the municipality's relationships with businesses and the success of on-street EV charging.
- 5. Land Use Mix** | Streets with a greater mix of land uses may be more suitable for an on-street charging station.



Example of an EV charging station mounted on a public utility pole in Los Angeles. Photo credit: Barry Lank

### On-Street Charging in Seattle

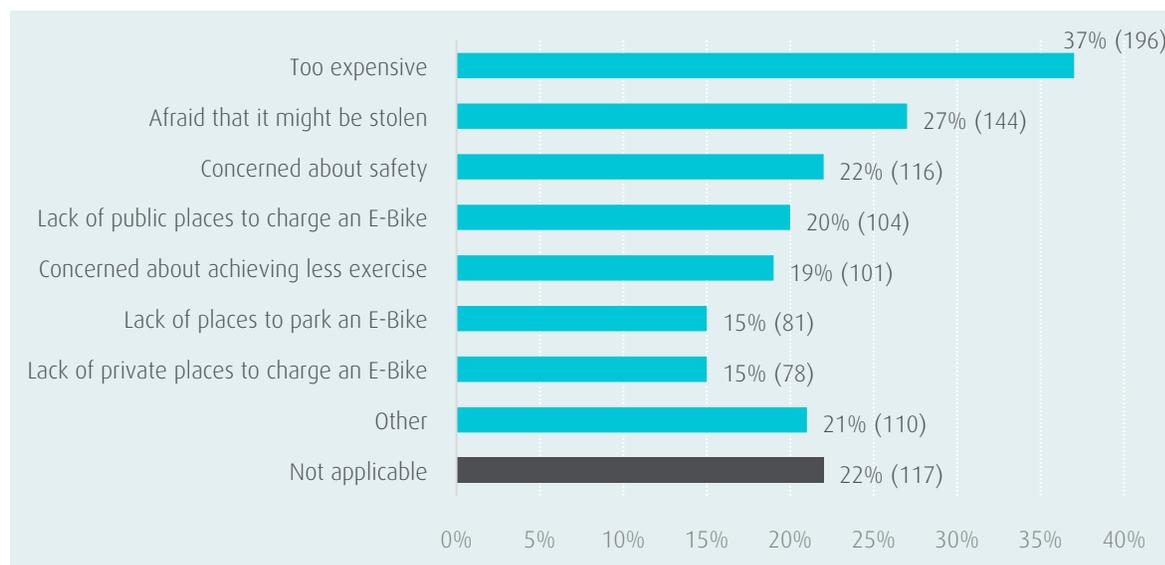
The City of Seattle implemented the EV Charging in the Public Right-of-Way (EVCROW) program in 2017, which is a pilot allowing for the installation of EV charging stations at curbside locations in the public right-of-way. . The City of Seattle's EVCROW program uses "Urban Centres and Urban Villages" as one of its siting criteria. This refers to the densest neighbourhoods in the city that provide a diverse mix of uses, housing, and employment opportunities. Its siting criteria include [a] Urban Centres and Urban Villages, and [b] commercial zoning frontage outside of Urban Centres and Urban Villages.

## 4.5 Public Locations for E-Bike Charging Stations

As discussed in [Section 2.3](#), range anxiety is not a commonly reported barrier by E-Bike users and prospective users. The literature has identified a number of other more prominent barriers facing E-Bike ownership including safety, lack of secure parking, and the social stigma associated with riding an E-Bike.

The CRD public survey found that concerns of bicycle theft and a lack of public charging locations were key barriers to E-Bike ownership. Refer to [Figure 11](#).

**Figure 11. Summary of Barriers to E-Bike Ownership, CRD Public Survey**



About 20% of survey respondents selected “lack of public places to charge an E-Bike” as a barrier, which has not been identified in the literature. A related question asked respondents if they would feel comfortable parking their E-Bike in a publicly accessible location. The responses were mixed on this question; a third of the 509 respondents checked “yes”, a third checked “no”, and the final third checked “don’t know, unsure at this time”.

A follow-up open-ended question asked “what would make you feel comfortable parking your E-Bike in a publicly accessible location”; common responses included:

- Locked or supervised area
- A secure designated E-Bike parking facility
- Surveillance cameras
- A paid parking facility for E-Bikers users

The survey data and literature confirm that, unlike EVs, the actual location of an E-Bike charging station is less important for overall use. What matters more is access to secure parking to minimize theft.

### 4.6 E-Bike Parking Design Guidelines

Based on the survey data presented in the previous section, there is an opportunity to address these concerns and increase E-Bike ownership in the Capital Region through the provision of bicycle parking that is purposefully designed to accommodate E-Bikes.

#### How to Design Bike Parking for E-Bikes?

Secure and well-designed bicycle parking intended for conventional bicycles will also appeal to E-Bike users. Based on the CRD public survey and barriers identified in the literature, E-Bike users place particular importance on the following three factors:

1. **Security** | Increase facility security to address theft concerns;
2. **Size** | Design larger bicycle parking spaces to accommodate E-Bikes; and
3. **Electrification** | Provide access to an electrical outlet to facilitate charging.

### Security

E-Bikes typically cost between \$2,000 and \$5,000, representing significantly higher costs than most conventional bicycles. As a result, E-Bike owners seek bicycle parking with a greater level of security to protect against bicycle theft as compared to conventional bicycle owners. This heightened level of security is also of benefit to conventional bicycle owners.

The following is necessary to achieve a basic level of security in long-term<sup>6</sup> bicycle parking facilities:

- Ensure all racks and mounting apparatuses are of a material and gauge that they cannot be physically altered / manipulated
- Ensure all racks and mounting apparatuses are securely fastened to the ground or wall
- Control access to shared bicycle rooms by way of a lock or keypad
- Ensure bicycle parking areas are adequately lit at all hours

The following are opportunities to further enhance security in long-term bicycle parking facilities:

- Provide individual, self-contained bicycle lockers
- Locate bicycle parking within view of high traffic areas to create “passive surveillance”
- Install video surveillance (CCTV) and associated signage in bicycle parking areas

Short-term bicycle parking, or less than two hours, does not require the same level of security as long-term facilities. Basic security is achieved by ensuring all racks and mounting apparatuses cannot be physically altered / manipulated and are securely fastened to the ground or wall.

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<sup>6</sup> Long-term bicycle parking facilities generally refers to use beyond two hours while short-term refers to use of less than two hours. For more, see the City of Victoria Bicycle Parking Strategy, available online at:

<https://www.victoria.ca/assets/Departments/Engineering~Public~Works/Documents/parking-bicycle-strategy.pdf>

## Size

There are an increasing number of cargo and larger bicycles in operation. The pedal assistance provided by an E-Bike makes larger bicycles capable of carrying cargo and/or multiple passengers more appealing. As a result, a greater proportion of E-Bikes are larger bicycles (both longer and wider) as compared to regular bicycles. Refer to **Table 10**. Accordingly, bicycle parking intended for E-Bikes should consist of a greater number of larger spaces to accommodate E-Bikes.

**Table 10. Typical Bicycle Dimensions**

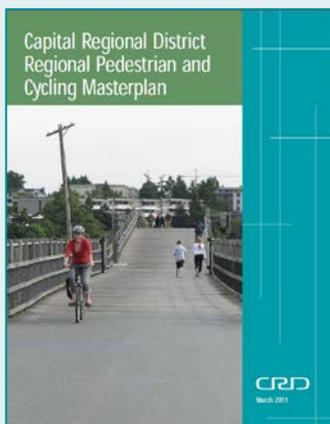
|        | Conventional Bicycle | Large / Cargo Bicycle | Difference |
|--------|----------------------|-----------------------|------------|
| Length | 1.8m                 | 2.5m                  | +0.7m      |
| Width  | 0.6m                 | 0.9m                  | +0.3m      |

\*Dimensions in the table above refer to the physical dimensions of the bicycles, not the operating envelope. They are based on the CRD PCMP design guidelines.

## Electrification

An E-Bike requires access to an electrical outlet to facilitate charging, which is typically achieved in one of two ways:

1. Charging infrastructure may be incorporated directly within the bicycle parking rack / mounting apparatus. This typically requires purpose-design placement of electrical conduit / receptacles in or adjacent the floor.
2. E-Bike parking may be located no more than 2 metres from a standard 110V wall receptacle. Attention should be given to ensuring the E-Bike parking location relative to the wall receptacle will not result in a tripping hazard or impede bicycle maneuvering.



### CRD Regional Pedestrian + Cycling Masterplan

Completed in 2011, the Pedestrian + Cycling Masterplan (“PCMP”) lays out a plan of action for achieving a significant shift in patterns and modes of transportation throughout the region. The PCMP, Appendix B, includes detailed guidance on the design of bicycle parking and other cycling trip end enhancements.

The PCMP is available on the CRD’s website: [www.crd.bc.ca/project/regional-transportation/pedestrian-cycling-master-plan](http://www.crd.bc.ca/project/regional-transportation/pedestrian-cycling-master-plan)

### What proportion of bicycle parking spaces should be designed specifically for E-Bikes?

Generally speaking, bicycle parking that is specifically designed for E-Bikes will also appeal to riders of regular bicycles. The added costs associated with E-Bike parking—security, size, electrification—are minimal and are significantly less than retrofitting a bicycle parking facility in future to accommodate E-Bikes.

The recommended proportion of bike parking spaces in new multi-unit residential buildings and commercial developments that should meet E-Bike design criteria are identified in **Table 11**. The recommendation is informed by research and E-Bike trends. The recommendation for 50% electrified for long-term bicycle parking spaces is derived from the City of Vancouver, which requires 50% of long-term bicycle parking spaces in new developments to have access to an electrical outlet.

**Table 11. Recommended Proportion of Bike Parking Spaces Meeting E-Bike Design Criteria**

|                            | Design Criteria |             |                       |
|----------------------------|-----------------|-------------|-----------------------|
|                            | Secure          | Electrified | Large / Cargo Bicycle |
| Long-term Bicycle Parking  | 100%            | 50%         | 10%                   |
| Short-term Bicycle Parking | -               | 10%         | 10%                   |

## 4.7 Usage Fees for Public Charging

Free charging has been the norm in municipalities around North America as it is largely seen as an effective way to incentivize use and support early EV adoption. However, free charging can also send an incorrect price signal about the cost of charging / using an EV and may result in opposition and decreased utilization when a fee is eventually introduced.<sup>27</sup>

Almost all municipalities in the Capital Region do not currently charge a user fee for public charging with the exception of the Township of Esquimalt, which has a nominal user fee of \$1.00 per hour.<sup>28</sup> As EV ownership and sales continue to rise in the Capital Region and BC more broadly, there may be additional demand for public charging stations, which justifies the need to implement a user fee for municipally managed stations.

Implementing a fee for charging station utilization is considered best practice in the longer term and should be pursued for the following reasons:

1. Limit the length of charging sessions and encourage turnover
2. Encourage at-home charging to reduce public costs
3. Manage increasing demand for public EV charging
4. Signal the value associated with receiving electricity for the vehicle

There are two main approach to usage fees, as follows:

1. **Price per kWh** | this approach is generally seen as fair and consistent but may not encourage turnover. Note: If fees are based on energy or power management, further federal approvals are required by Measurement Canada<sup>7</sup>.
2. **Price per time** | pricing by time can encourage turnover as users pay a fee for every minute or hour they use the station. Note: If fees for the use of charging stations are based on time, they are currently exempt from inspection or any intervention by Measurement Canada<sup>7</sup>.

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<sup>7</sup> See federal, Measurement Canada brief here: <https://www.ic.gc.ca/eic/site/mc-mc.nsf/eng/lm04839.html>

Table 12. Usage Fees for Charging in Select Jurisdictions

| Municipality / Operator | Basis of Fee |             | Fee                         |           |
|-------------------------|--------------|-------------|-----------------------------|-----------|
|                         | Time         | Electricity | Level 2                     | Level 3   |
| Esquimalt, BC           |              |             | \$1 / hr                    | --        |
| Montreal, QC            |              |             | \$2.50 / charge OR \$1 / hr | \$10 / hr |
| NB Power                |              |             | \$0.30 / kWh                | \$15 / hr |
| Nova Scotia Power       |              |             | \$0.30 / kWh                | \$15 / hr |
| Vancouver, BC           |              |             | \$2 / hr                    | \$16 / hr |
| Whistler, BC            |              |             | \$0.35 / kWh                | --        |

When establishing a usage fee, consideration should be given to the comparable costs of fuel for a gas-powered vehicle. Usage fees should be set below the costs of gasoline to provide costs savings for EV owners and to broadly help accelerate the adoption of EVs. Table 13 below presents EV charging costs, calculated as an equivalent cost of gasoline.<sup>8</sup>

Table 13. EV Usage Fees Compared to Cost of Gasoline<sup>29</sup>

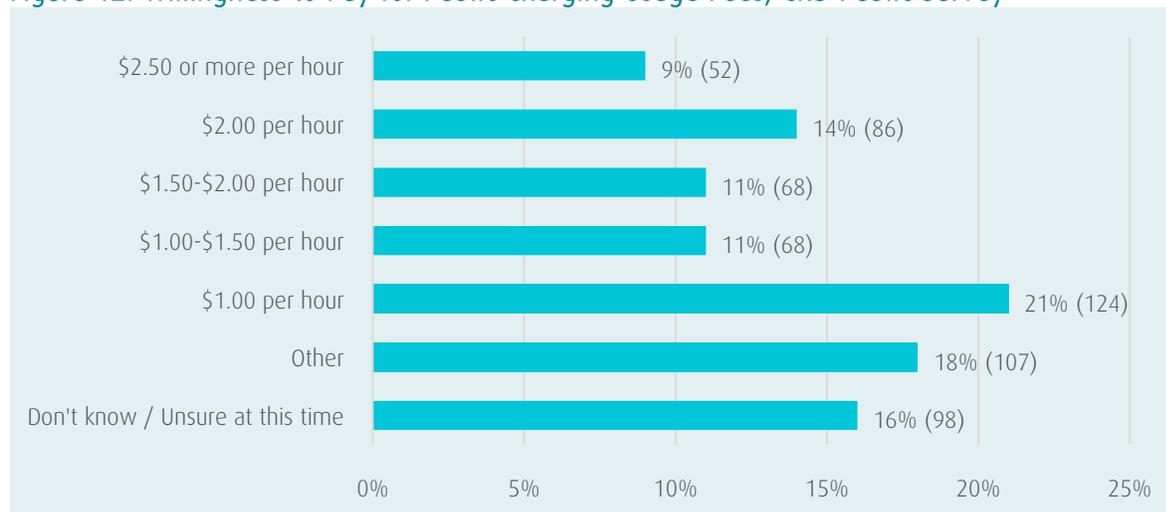
| Type of Charging        | Rate       | Cost for 100km<br>(assumes 20kWh/100km) | Equivalent Gas Price<br>(assumes 8L/100km) |
|-------------------------|------------|---|--|
| Charging at Home        | \$0.11/kWh | \$2.20                                  | \$0.28/L                                   |
| Public Level 2 Charging | \$1/hour   | \$3.03 (@6.6kW)                         | \$0.38/L                                   |
| Level 3 DCFC 50kW       | \$16/hour  | \$6.40 (@50kW)                          | \$0.80/L                                   |
| Level 3 DCFC 30kW       | \$16/hour  | \$10.67 (@50kW)                         | \$1.33/L                                   |

As shown in Figure 12, the majority of respondents in the CRD Public Survey indicated they would be willing to pay \$1.00 / hour for public charging. Open-ended responses to this question included

<sup>8</sup> Table adapted from Dunskey Energy Consulting.

everything from public charging stations should be free, to higher willingness to pay for a Level 3 station, to not charging per hour but by time or use. Overall, there is support to introduce usage fees for public charging.

**Figure 12. Willingness to Pay for Public Charging Usage Fees, CRD Public Survey**



### **Recommendation: Implementing Hourly Usage Fees in the Capital Region**

Based on best practices and implementation ease, consideration should be given to implementing **hourly usage fees** for public stations in the Capital Region. An hourly fee is easier for a user to understand and can also encourage higher turnover compared to the option of paying per kWh. A rate of **\$1 per hour** for Level 2 stations is seen as appropriate for introducing usage fees, which is consistent with the Township of Esquimalt and the results of the public survey. The fee could be adjusted based on overall utilization of the stations.

A rate of **\$16 per hour** is recommended for Level 3 DCFC stations (50 kW), which is consistent with the rate in the City of Vancouver. These fees result in a higher cost than charging at home, but still offer cost savings when compared to a gasoline-powered car.

If usage fees are adopted, it should be noted that local governments may be required to pay licensing fees to access the pricing function.

### 4.8 Procurement Practices

In June 2017, the Province of BC released a Corporate Supply Arrangement (CSA)<sup>9</sup> for supply and installation of electric vehicle charging stations.<sup>30</sup> The purpose of the CSA is to reduce procurement timelines for climate action-related goods and services that best support climate action-related planning. The supply arrangement is available to all BC government ministries as well as other broader public sector organizations, including local governments. Utilizing a streamlined procurement process, the CSA allows local governments to purchase the following:

- Level II charging stations for electric vehicles
- Installation for electric vehicle charging stations
- Optional features such as hangers and plugs

The Province of BC website includes the full details regarding the CSA.<sup>10</sup> Importantly, the CSA includes a number of required standards and certifications that the EV charging stations must meet. Local governments in BC have access to the CSA, which include the following provisions

- CSA, Underwriters Laboratories, or other recognized certification approved for use in Canada
- Weatherproof to minimum of NEMA 3R
- Ability to operate in a temperature range of -30 to 50C
- Charging station cord is a minimum of 5.5m in length and has a universal SAE J1772 compliant connector
- Network capable units are Building, Automation and Control (BACnet) compatible

The output and input functions must be:

- Capable of Level 2 AC charging, minimum rated voltage and amperage of 208V/240V and 40A
- Compatible with incoming voltage 208V-240V
- Over-current protection that prevents circuit breaker trips

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<sup>9</sup> Corporate Supply Arrangements (CSAs) are supply arrangements which are available to all ministries and may also be available to broader public sector organizations.

<sup>10</sup> <https://www2.gov.bc.ca/gov/content/governments/services-for-government/bc-bid-resources/goods-and-services-catalogue/ev-charging-stations#info>

Beyond the requirements identified above in the CSA, there are a number of other minimum specifications that local governments should consider when purchasing Level 2 charging stations for their respective communities. The City of Surrey uses the following specifications.

### Management / Reporting:

- Financial management platform for payment processing and reporting
- Web-portal access to performance metrics via dashboard & report application, including
  - Location of chargers
  - Latest metered power
  - Electric km delivered
  - Total energy delivered
  - Total electric km
  - Total GHG emissions avoided
  - Load statistics (min/max)
  - Number of stations
  - Station status
  - Charging Activities (current/daily/monthly/by date range)
  - Trends by selectable date ranges

### Software Features:

- User app for payment, usage notification, etc.
- Compatibility with parking enforcement systems and 3rd party hardware solutions
- Load management, or building energy management capabilities
- Payment system PCI compliance
- Seamless interoperability/payment acceptance with other EVSE user/payment apps

### Joint Purchasing

Many local governments within in the Capital Region participate in the Greater Victoria Joint Purchasing Group (GVJPG). The GVJPG was formed by public organizations that are responsible for purchasing goods and services. The purpose of the GVJPG is to increase the purchasing power of the individual participants by obtaining favorable pricing through competitive processes, increased

collective volumes and contract administration. Additional participating organizations may opt to enter into a contract with the successful vendor for the purchase of the products and services described in a specific RFP based on the terms, conditions, prices and percentages offered by the vendor in the original proposal. The GVJPG could be used as a vehicle to purchase EV and E-Bike infrastructure that could provide procurement benefits, while providing flexibility to participants.

## 5. EV & E-Bike Charging in New Development

This section provides an overview of how local governments could increase opportunities for EV and E-Bike charging in new developments. The BC Building Act provides provincial legislative direction, but local governments also have the ability through policy, regulation, and incentive mechanisms to increase EV and E-Bike charging in new developments. This section draws on content from the provincial guide (“Residential Electric Vehicle Charging: a Guide for Local Governments”) and feedback collected through the CRD developer’s survey and workshop, *Backgrounder, Section 8.2*).

A discussion of considerations for existing buildings can be found in [Section 6.0](#).

### 5.1 BC Building Act

The BC government has indicated that local government EV charging requirements are “out of scope” of the Building Act. As such, the BC Building Act does not directly impede local governments’ ability to implement requirements for electric vehicle charging infrastructure, as noted in the Building Act Guide, as follows:

- If the requirements do not concern a matter addressed in the Building Code, they are ‘out of scope’ of the Building Act and local governments can regulate these matters if they have authority to do so in other statutes.
- Electric vehicle charging stations/plug-ins: Electric vehicle charging stations concern the number, location, and type of charging stations (and related matters such as signage) required in a building or facility to charge electric vehicles that use the building for parking. This includes wiring or pre-ducting for electric vehicle plug-ins.

More information about the BC Building Act is found in Section 2.0 of the provincial guide.

### 5.2 Local Government Policy Mechanisms

Local governments have a menu of policy options available to them to support EV and E-Bike charging in new developments. A summary of each mechanism is discussed below. This section is primarily focused on EVs.

### Planning Policy

**Section 3.3** identified local government OCP policies in the Capital Region that support EVs. In general, the OCP policies direct the municipality / electoral areas to accelerate the adoption of EVs within their communities. Specifically, the policies support the provision of EV charging stations in public locations and the installation of charging infrastructure in new developments. Some municipalities such as Saanich and Victoria have adopted specific climate action plans, which provide further direction around the role of electric vehicles in meeting municipal climate goals.

A Community Energy and Emission Plan (CEEP) is an example of another high-level policy document that may provide recommended actions to advance policy requirements or negotiate EV charging infrastructure during rezoning.<sup>31</sup>

### Negotiating EV Charging Infrastructure – Rezoning & Development Approvals

Another tool local governments could use to accelerate EV adoption is to adopt a formal or informal policy that includes negotiated provision of EVSE in new residential construction as part of rezoning or contingent on development approval. One of the main benefits of this mechanism is that it can allow both local governments and developers / builders to become comfortable and acquainted with EV charging infrastructure prior to a formal requirement.

This mechanism, however, presents several potential drawbacks<sup>32</sup>, as follows:

- Each development must be negotiated separately, which may require greater administrative resources / time
- The EV charging infrastructure requirement may not be fully known, resulting in project costing uncertainty
- The level of EVSE installed may be insufficient to meet future demand
- Proposed developments that are not subject to a rezoning would be excluded from this process
- In strata-owned buildings, a policy that negotiates or requires only a percentage of residential parking stalls to be EV-ready or wired for EV charging could result in future conflicts within the strata. With EV ownership continuing to rise, a mismatch could occur between EVSE-serviced parking stall ownership and EV owners requiring a charge

### Zoning Bylaw

Communities such as the Town of View Royal have taken the approach to require EV charging infrastructure for residential and commercial uses in their zoning bylaw (see [Section 3.3](#)).

Advantages to this approach are as follows:

- EVSE and/or charging station requirements can be tailored to various residential land use designations including single family, duplexes, multi-unit residential, or townhomes, for example
- EVSE requirements through the zoning would require all new construction in those zones to provide EVSE infrastructure

One of the main challenges with this approach is that some municipalities may have multiple residential designations, which could add complexity and significant resources to the process. In addition, this approach also limits flexibility. For example, a proposed development may include EV charging infrastructure and meet the intent of the bylaw but may not meet every stated requirement. If it does not meet every requirement, the applicant would have to apply for a variance, which adds additional time and process to development applications.

### Parking Bylaw or Schedule

Another policy mechanism that is becoming commonplace is the introduction of a requirement in a parking bylaw or schedule requiring parking stalls in newly constructed residential buildings to include EV charging infrastructure. As discussed in the *Backgrounder, Section 4.3*, a number of municipalities in Metro Vancouver including Richmond, Burnaby, Vancouver, the District of North Vancouver, and Port Coquitlam are using this policy mechanism to require Level 2 charging access in new residential dwellings.<sup>33</sup>

The greatest advantage of this mechanism is its simplicity and flexibility to both local governments and developers alike. It allows the local government to set a percentage or number of EVSE-ready stalls per unit, which is applied to all new residential parking stalls.

The City of Richmond has identified electric vehicles as an important component of advancing sustainability. The City recently amended Section 7 (Parking and Loading) of its Zoning Bylaw to require that all new residential parking stalls feature an energized outlet capable of providing “Level 2” EV charging.

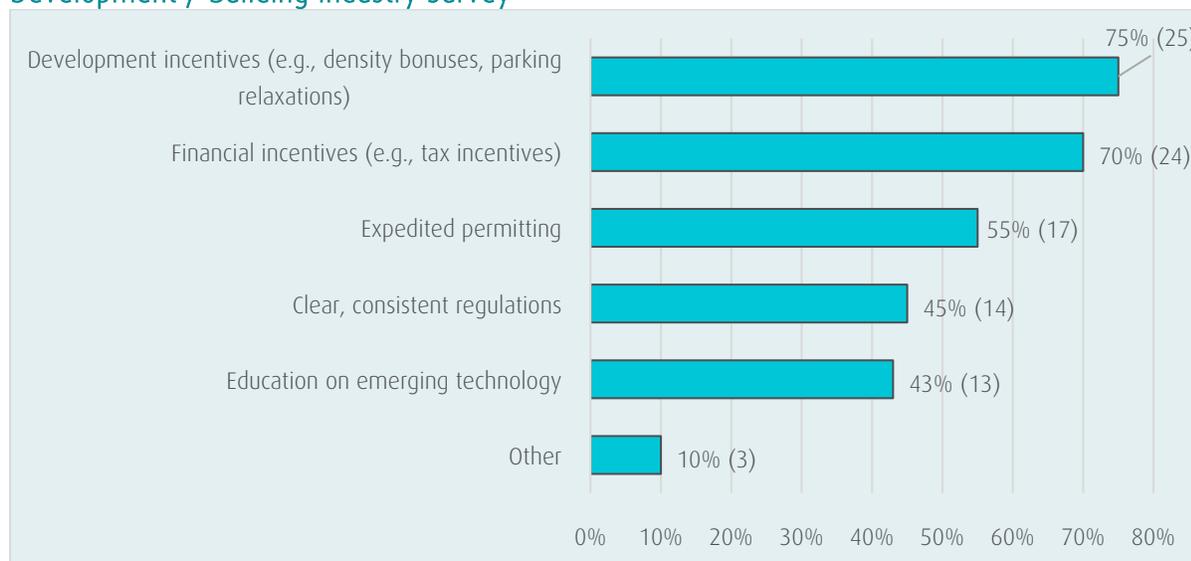
### Incentive Mechanisms

In addition to the mechanisms described above, local governments could employ a variety of policy / incentive tools in the short-term to advance EV charging infrastructure in new developments. These short-term mechanisms can help create momentum and familiarity with EV charging in new development. Examples are provided as follows:

- **Density Bonuses** | A density bonus (i.e., an increase in the floor area ratio) can incentivize the inclusion of EV charging infrastructure in a new development. While this mechanism has not been widely applied in the BC context, communities such as the City of Port Coquitlam are considering this tool. The City is in the process of updating its zoning bylaw to include requirements for electric vehicle charging infrastructure. To offset the cost of providing the EV charging infrastructure, the City will consider reductions in Community Amenity Contributions or density bonus contributions.<sup>34</sup>
- **Community Amenity Contributions** | Community amenity contributions (CACs) are negotiated amenity contributions agreed to by the developer and local government as part of a rezoning process initiated by the developer. Community amenity contributions typically include the provision of amenities, affordable housing and/or financial contributions towards amenities. The agreed-to contribution is obtained by the local government, if the local government decides to adopt the rezoning.<sup>35</sup>

The CRD development / building industry survey asked respondents how local governments can support EV charging infrastructure in new developments. As shown in [Figure 13](#), the majority of respondents (75%) indicated that development incentives would be preferable compared to other actions such as expedited permitting, for example.

Figure 13. Actions to Support EV Charging Infrastructure in New Developments, CRD Development / Building Industry Survey



### 5.3 Charging Requirements – Infrastructure Considerations

As reported by multiple sources, the majority (over 90%) of EV owners charge their vehicle at home or at work.<sup>36</sup> In addition, the provision of EV and E-Bike charging opportunities in suburban residential areas are especially critical as these residents may not have access to the same sustainable transportation options as their urban counterparts. This section provides information about the types of charging infrastructure to consider for residential land uses including costs and electrical needs.

#### Requirements for Single-Family Homes, Duplexes, and Townhouses

As discussed in [Section 2.2](#), EV charging at home can either be done with a regular 110V outlet (i.e., Level 1), or with a Level 2 (208/240 volt) charging station. An 110V outlet is sufficient for the purposes of charging an E-Bike; however, a Level 2 EV charger is recommended for residential land uses with a driveway or off-street parking such as a single family home, duplex, or townhouse. Section 2.4 of the provincial guide reported that charging stations rated at 40A (i.e., 208-240V) provide a reasonable charge time and allow for load sharing.

If no additional circuits are available for the charging infrastructure and dedicating a 40A circuit would lead to a panel upgrade and additional costs, a “load miser” or “watt miser” is recommended. These would allow a Level 2 charger to share a circuit with a dryer or a stove; the

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EV could only charge when the appliance on the circuit is not in use. This load sharing option is permitted under the Canadian Electrical Code.<sup>37</sup>

The costs of EVSE to support a Level 2 charger vary and are subject to a number of factors including the building and site configuration, calculated load, and panel size. The provincial guide (page 17) provides a summary of these costs, which are shown below (these are estimates only):

- **New construction** | \$200-\$500 per dwelling unit, which includes materials and labour for an energized outlet on a dedicated 40A 240V circuit
- **Retrofitting** | \$500-\$1,200 per dwelling unit
- **Total cost of EVSE / Charger** | \$600-\$1,400 plus labour to hardwire

### Requirements for Multi-Unit Residential Buildings

Those living in a multi-unit residential building may not have access to charging opportunities for their EV or E-Bike and presents a significant barrier to accelerating EV adoption in multi-unit residential buildings.

Retrofitting the building for EV infrastructure can be cost prohibitive and complex due to shared parking configuration in multi-unit residential buildings. Some data show that the installation costs, which include EVSE and labour, were averaged to be \$6,800 per retrofit EV parking stall.<sup>38</sup>

While retrofitting is an option, albeit an expensive one, ensuring EV charging infrastructure is installed at the time of construction can significantly reduce the cost and institutional barriers to EV ownership. [Table 14](#) includes a summary of the costs of installing EVSE.

Table 14. EV-Ready Installation Costs Per Stall<sup>11</sup>

| Type of Charging <sup>12</sup> | Costs (\$/stall)**        |                 |           |
|--------------------------------|---------------------------|-----------------|-----------|
|                                | Townhouse                 | Mid-Rise        | High-Rise |
| Dedicated Level 1*             | \$126 (least cost option) | \$847-\$881     | \$1,443   |
| Dedicated Level 2              | \$2,655                   | \$2,314-\$2,448 | \$3,023   |
| Load Sharing, Level 2***       | \$307                     | \$566-\$572     | \$760     |

\*No additional life cycle costs for Level 1

\*\*Additional life cycle costs are estimated at \$8000 over 20 years, assuming \$2,000 per Level 2 charger and \$6,000 in services costs

\*\*\*This depends on the building type but assumed a 4-way load sharing arrangement or 18-way load shared with an 80A circuit

## 5.4 Model Language for New Development

As local governments explore different policy mechanisms to advance EV and E-Bike charging infrastructure in new developments, consideration should be given to policy and regulatory language that has already been adopted. This section includes examples of regulatory language that been included in municipal zoning bylaws stating the requirements for EV and/or E-Bike charging infrastructure.

Note: it is recommended that municipalities / electoral areas focus on advancing EV-ready requirements, which can [a] allow for the future installation of EV charging stations based on demand and [b] not represent a significant cost for developers / builders.

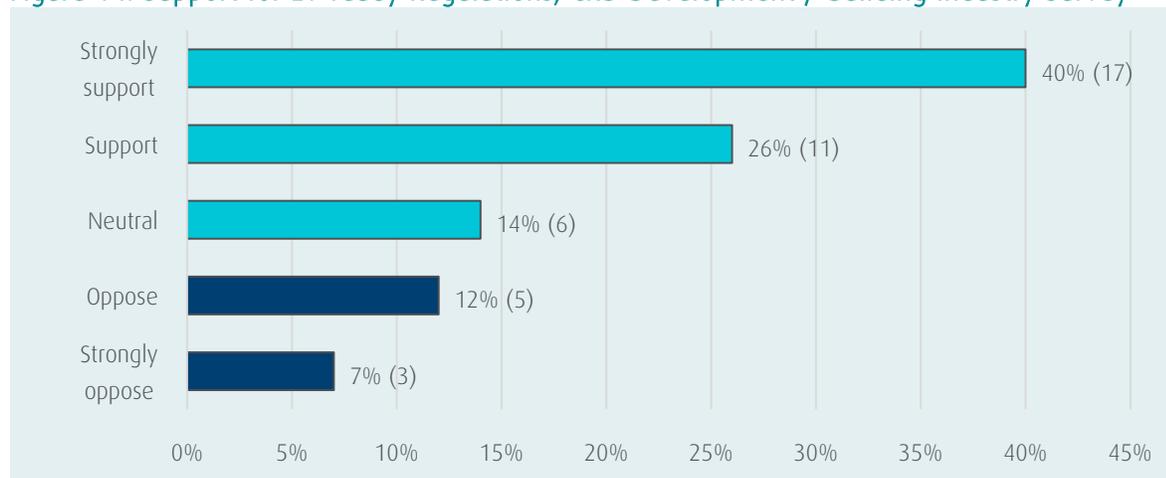
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<sup>11</sup> This table has been adapted from the provincial guide “Residential Electric Vehicle Charging: A Guide for Local Governments”.

<sup>12</sup> “Dedicated” refers to dedicated circuits, which is intended for a single appliance such as dryer, oven, or in this case, an electric vehicle. “Load sharing” can significantly reduce the infrastructure costs associated with EVSE installation by avoiding the inherent costs of dedicated circuits. According to AES Engineering Ltd, a Level 2 load sharing installation is less than one-third the cost of a dedicated circuit installation.

An important part of developing EV-ready policy and regulations is obtaining feedback from the developer / building industry. As such, questions were included in the CRD development / building industry survey to gauge their support. As shown in [Figure 14](#), most of the survey respondents (41%) strongly support local governments in the Capital Region requiring new developments to be EV-ready. Even though the majority of the survey respondents selected “development incentives” as the top local government action to support EV charging infrastructure in new developments, the findings below indicate that there is strong support for EV-ready regulations in the Capital Region. However, local governments should consider further consultation with the development / building industry community before adopting EV-ready regulations.

**Figure 14. Support for EV-ready Regulations, CRD Development / Building Industry Survey**



The recommended regulatory language for both EV-ready and E-Bike parking requirements are provided on the following page. In addition to the requirement to have access to an EV-ready parking stall, regulations should also include a requirement for labelling the outlet for EV charging to deter other non-EV users and to increase the visibility of EV charging. In addition, to allow for future load sharing / load management, the regulations should communicate the requirements for a performance standard for EV energy management.

The City of Richmond created a bulletin on [Electric Vehicle Charging Infrastructure Requirements](#) that provides a clear and concise explanation of the EV Charging Infrastructure Requirements that were adopted in that City in 2017. The bulletin can serve as a useful guide for local governments when they consider similar regulations.

The following regulations are recommended for local governments in the Capital Region:

#### Residential EV-Ready Requirements

*For new buildings, structures and uses, all residential parking spaces, excluding visitor parking spaces, shall feature an energized outlet capable of providing Level 2 charging or higher to the parking space.*

*Energized outlets, provided pursuant to section xx.x(1) above, shall be labelled for the use of electric vehicle charging.*

*Where an electric vehicle energy management system is implemented, the Director of Engineering may specify a minimum performance standard to ensure a sufficient rate of electric vehicle charging.*

#### Commercial EV-Ready Requirements

*For new buildings, structures and uses, 10 percent of all commercial parking spaces shall be provided with an energized outlet capable of providing Level 2 charging or higher to the parking space.*

#### E-Bike Parking Requirements (Multi-Unit Residential & Commercial)

##### Long-Term Bicycle Parking:

*One 110V electrical outlet must be provided for every two long-term bicycle spaces.*

##### Short-Term Bicycle Parking:

*10% of bicycle parking spaces must have access to an 110V electrical outlet.*

## 6. Retrofitting

This section is directly based on and summarizes content from the provincial guide (Section 3.0). While retrofitting is more costly than EVSE installation at the time of construction, it is needed to provide viable charging opportunities. This section presents a summary of how local governments can help alleviate barriers and support retrofits in multi-unit residential buildings.

### 6.1 Cost Barriers & Solutions for Multi-Unit Residential Building Retrofits

There are two cost barriers when retrofitting multi-unit residential buildings to add EV charging infrastructure.

1. **Upfront Costs:** immediate costs are incurred during the process of retrofitting, including the required electrical permits to perform the work, labour, materials, and the EV supply equipment (EVSE).
2. **Long-term Costs:** long-term costs are incurred when the building reaches the capacity of its electrical service (e.g., through the addition of additional EV infrastructure in the building over time or other factors that increase the building's electrical load), requiring capacity upgrades to the building to accommodate additional EV infrastructure.

For upfront costs:

- Data from PlugIn BC indicates the cost for multi-unit residential building retrofits in British Columbia can range from \$4,000 to \$8,000 per dwelling unit with an average of \$6,800 per unit. Whole building retrofits would be much greater.
- As a result, this high upfront cost can be a barrier among building owners and/or strata corporations as it reduces the financial feasibility of retrofits and the cost effectiveness depending on the number of building residents who own an EV vehicle.
- To address this cost, the Province of BC is recently offered an incentive program to cover 75% of costs, up to \$4,000, for the installation of a Level 2 charging station. This can potentially reduce the average cost to \$2,800 for each station installed. This program closed in July 2018 as the funding was fully allocated.

For long-term costs:

- Typically a cost estimate is \$5,000 for an addition 200A of service (sufficient for five 40A charging stations operating in parallel, or additional stations operating with load-sharing technology, also known as EV energy management systems).
- Costs could be higher if an upgrade to the distribution transformer (that converts high-voltage electricity to lower voltage levels for consumer use) is required.
- As a result, building residents may be reluctant in supporting retrofits unless the costs are evenly distributed in order to address issues of perceived unfairness where early adopters pay less than later consumers to obtain EV charging station.

One of the most viable solutions to address these costs is to design for EVEMS (i.e., load sharing), which would allow for a greater number of parking spaces to be served within the limited electrical capacity of an existing building. The use of an EVEMS to redesign electrical service in the building to accommodate EV infrastructure for each parking space would be significantly more cost-effective than adding EV infrastructure to select parking spaces in an ad hoc approach. A full discussion of the costs of different load sharing options is available in a City of Richmond costing report titled “Electric Vehicle Charging Infrastructure in Multifamily Developments – Requirement Options and Costing Analysis”.<sup>39</sup>

## 6.2 Social and Legal Barriers & Solutions for Multi-Family Building Retrofits

There are social and legal barriers that pertain to retrofitting multi-family buildings. In apartment buildings, landlords are typically the only decision-maker and determine whether EV charging should be provided. A tenant may submit a request to the landlord (and go through dispute resolution if necessary) to install EV charging infrastructure, but landlords are not required by law to provide charging access to EVs.

For strata buildings, there are additional social and legal barriers beyond those encountered for apartment buildings that require the involvement of the strata corporation. In general, strata boards are more risk-averse and less inclined to learn about and agree to EVSE upgrades. As a result, they may be less willing to invest in a legal review to determine if the retrofits are feasible.

The following identifies more examples of barriers and potential solutions for multi-unit residential building retrofits, as reported in the provincial report.

### Swapping Parking Stalls

The installation of EVSE may not be appropriate for each parking stall; whether an EV user may be permitted to access a parking stall may be dependent on how the stall is held, as follows:

- **Common property:** In some cases, these parking stalls may be assigned, and the strata corporation has the ability to reassign them. In other cases, the common property stall may be held through a lease, and the provisions of this lease will indicate whether owners may trade stalls.
- **Limited common property:** The ability to swap a limited common property stall depends on how it was designed. Sometimes a resolution must be passed unanimously at an annual or special general meeting. In other cases, an application may be required to amend the strata plan, which is costly and can be complex.
- **Strata lot:** The strata corporation has no authority to swap these spaces because each space is the property of the registered owner.

### Strata Resolutions Required for Electric Vehicle Infrastructure Installation

Municipalities should be mindful of the following barriers when requiring EV infrastructure installation:

- A multi-family building owned by a strata corporation require a three-quarter strata majority to pass a bylaw that allows for the installation and use of EV infrastructure
- Residents may decline a request for EV infrastructure without reasonable cause by voting against the strata resolution. This has been reported as one of the most common barriers for multi-family building EV charging retrofits.<sup>40</sup>
- One of the main reasons why resolutions fail is due to the perception that EV charging will benefit only a small number of strata members. Moreover, members who do not see a benefit may be reluctant to share the cost of any infrastructure upgrade. Strata corporations can alleviate this barrier by clearly articulating options for cost recovery and cost sharing

### Supporting Access to Electric Vehicle Charging in Existing Residential Development

According to research by Plug In BC, there are a number of education and outreach initiatives that can be pursued to improve the chances of EV infrastructure being approved by a strata corporation, as follows:

- Explaining how strata corporations can ensure EV owners are paying for their electricity (whether through metered, networked, or fixed-fee solutions) can significantly improve reception to the purchase and installation of EV infrastructure.
- The provincial charging program has an EV Advisor<sup>13</sup> who spends time with residents, strata councils, and strata memberships (at annual general meetings or special general meetings) to provide information, answer questions, and address concerns. Stratas have responded positively to the availability of a third-party information source that does not have a vested interest in selling EV infrastructure.
- Municipalities can consider having someone trained on staff, or in a combined Energy Advisor role, to provide this resource to residents and strata corporations. There may also be an opportunity to align outreach with existing programs or regional initiatives to take advantage of cross-promotional opportunities as they arise.
- Metro Vancouver's EVcondo.ca<sup>14</sup> is an online web resource that has FAQs for strata members and residents. Plug In BC also has a resource called navigating stratas<sup>15</sup> page has additional resources.

To overcome potential barriers to installing EVSE in multi-family buildings, a strata corporation could work with the EV owner to have them to pay for the ongoing operational costs, including the cost of electricity, some cost recovery on the infrastructure, and the network fee (if applicable). If the charging station is located in their parking stall, the EV owner could pay for the charging station hardware and installation. This can help reduce the financial burden on the other residents and provides transparency on how costs would be covered.

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<sup>13</sup> More information about the EV Advisor is available online at: <https://pluginbc.ca/incentives/charging-solutions-incentives/>

<sup>14</sup> More information about this Metro Vancouver resource is available online at: <http://www.metrovancouver.org/services/air-quality/climate-action/transportation-programs/ev-strata-condo/Pages/default.aspx>

<sup>15</sup> More information about Plug In BC's navigating stratas website is available online at: [https://pluginbc.ca/charging-stations/nav\\_stratas/](https://pluginbc.ca/charging-stations/nav_stratas/)

- Strata members in communities with new-build EV infrastructure requirements have been more likely to see EV infrastructure not as a cost but as an investment in their unit's eventual resale value.

### 6.3 Strata Rule Recommendations and Cost Reconciliation Issues

Section 4.0 of the provincial guide includes a series of recommendations for how local governments could encourage EVSE installation in new and existing multi-family buildings. Specifically, municipalities should consider the following **recommendations** as part of rezoning and approvals processes for new buildings:

1. Encourage developers to enter into a covenant under section 219 of the *Land Title Act*, which requires the owner of the land to keep the EVSE in operation. The covenant would be binding on the strata corporation. This is to avoid a situation where a strata council, by 3/4 vote, amends its bylaws to decommission or prevent use of EVSE.
2. Encourage developers to include the following in the strata corporation bylaws:
  - a. the right of an owner, occupant, or tenant to install EVSE in the appropriate parking stall, provided they sign an Alteration and Indemnity Agreement on EVSE installation;
  - b. the responsibilities of a strata corporation to manage and maintain the common property electrical infrastructure intended for EV charging, including costs of future repairs, maintenance, and upgrades to applicable electrical infrastructure, excluding EVSE; and
  - c. the responsibilities of an owner, occupant, or tenant with regard to installation and use of EVSE.

Stratas could consider various requirements in their bylaws to help facilitate EVSE installation. For example, if an owner, occupant, or tenant is requesting to install EVSE in a common property stall, the strata could:

- Require them to notify and/or obtain consent from the strata corporation priority to the installation.
- The owner / occupant / tenant could sign an Alteration and Indemnity Agreement where the terms would be determined by the strata council.

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- Require the owner / occupant / tenant to pay a user fee, where the amount should be fair and reasonable.

In situations where the strata is installing EVSE for use in a common property stall that would be used by multiple tenants, the strata could:

- Set out the amount of the user fee and how it will be charged and collected
- Determine how the parking stall will be used and managed including [a] whether consent and a user agreement must be obtained and signed before using the stall [b] time limits on how long the user could use the stall' and [c] whether visitors are allowed to park in the stall

More details around strata rule recommendations and cost reconciliation issues is found in the report: *Residential Electric Vehicle Charging: A Guide for Local Governments*.

## 7.0 Resources

In addition to the content found in *Infrastructure Planning Guide*, there are a number of resources that can assist in municipalities in advancing both EV and E-Bikes in their respective jurisdictions. A summary of resources is found below:

- **Residential Electric Vehicle Charging: A Guide for Local Governments** | The guide provides municipalities with specific guidance around improving access to at home EV charging in both new and existing residential buildings. <https://pluginbc.ca/wp/wp-content/uploads/2018/10/Residential-EV-Charging-A-Guide-for-Local-Governments.pdf>
- **Electric Vehicle Charging Infrastructure in Shared Parking Areas: Resources to Support Implementation & Charging Infrastructure Requirements** | This guide provides resources to support implementation of EV charging infrastructure in shared parking areas with direction on infrastructure configurations, delivery models, variance request requirements, and considerations for strata bylaws. <https://pluginbc.ca/wp/wp-content/uploads/2018/10/EV-Charging-Infrastructure-in-Shared-Parking-Areas-Resources-to-Support-Implementation-and-Requirements.pdf>
- **City of Richmond Electric Vehicle Charging Requirements Bulletin** | A concise document intended to inform owners/applicants, designers and builders of new residences of requirements for residential parking spaces to feature electrical outlets capable of providing “Level 2” electric vehicle charging:  
[https://www.richmond.ca/\\_shared/assets/engineering0549762.pdf](https://www.richmond.ca/_shared/assets/engineering0549762.pdf)
- **Capital Region Local Government Electric Vehicle (EV) + Electric Bike (E-Bike) Infrastructure Backgrounder** | This document provides baseline information that has been collected and analysed to inform this Guide.
- **Provincial Clean Energy Vehicle Program** | BC’s Point of Sale Incentive Program designed to make clean energy vehicles (CEV’s) more affordable for British Columbians:  
<https://www.cevforbc.ca/clean-energy-vehicle-program>
- **Provincial EV Charging Station CSA** | Provides information about the provincial Corporate Supply Arrangement for the supply and installation of EV Charging stations:

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<https://www2.gov.bc.ca/gov/content/governments/services-for-government/bc-bid-resources/goods-and-services-catalogue/ev-charging-stations>

- **Plug In BC** | Plug In BC is a program of the Fraser Basin Council and is a broad collaborative between government, industry, academic institutions, EV owners, NGOs and utilities. The program lays the groundwork for plug-in electric vehicles and related charging infrastructure in British Columbia:

<https://pluginbc.ca/>

- **City of Vancouver EV Ecosystem Strategy** | The City of Vancouver's EV Ecosystem Strategy builds on the City's experience with electric vehicles since 2007 and formalizes its role in the expansion of charging options until the year 2021:

<https://vancouver.ca/files/cov/EV-Ecosystem-Strategy.pdf>

- **Emotive** | a BC wide campaign to promote electric vehicles: <https://pluginbc.ca/outreach/>

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