APPENDIX A

Electric Vehicle Infrastructure Roadmap

Transportation electrification for a connected region

Prepared for:

Capital Regional District

Making a difference...together

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dunsky

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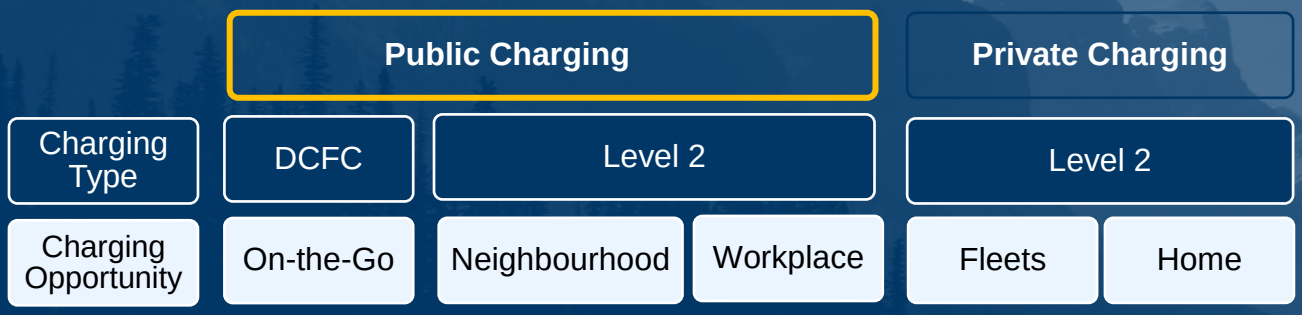
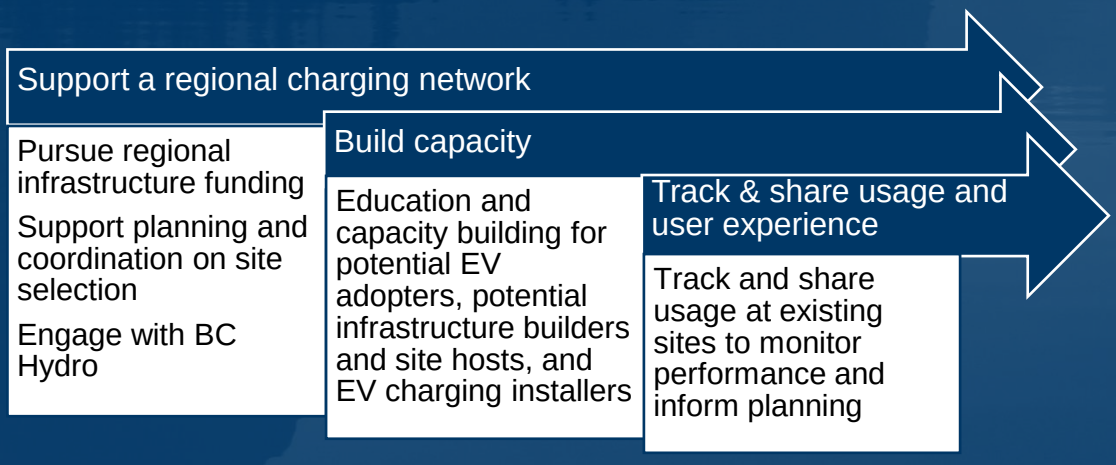
EXECUTIVE SUMMARY

The capital region has experienced record-breaking EV sales over the past several years and has a range of policies and plans in place to support EV adoption. However, to achieve a regional EV goal of 25% of all vehicles, additional charging infrastructure will be required.

Although charging at home in a garage or driveway is typically the most convenient option, not all EV drivers can plug in at home. Therefore, investment in public charging, including DCFC on-the-go, and Level 2 chargers in neighbourhoods and workplaces, is critical to ensuring equitable access to charging. This Roadmap estimates that 770 new public Level 2 ports and 132 new DCFC ports will be required by 2030 to accelerate adoption and support EV user needs.



The ramp-up of EV charging represents a significant investment of time and resources by a wide variety of different actors. There are significant opportunities to collaborate and ensure a coordinated approach to infrastructure deployment. The CRD has a vital role to play in leading collaboration opportunities, expanding its role as a trusted reference, and acting as the region's EV infrastructure advocate. To achieve this goal, the CRD should pursue the following collaboration opportunities:



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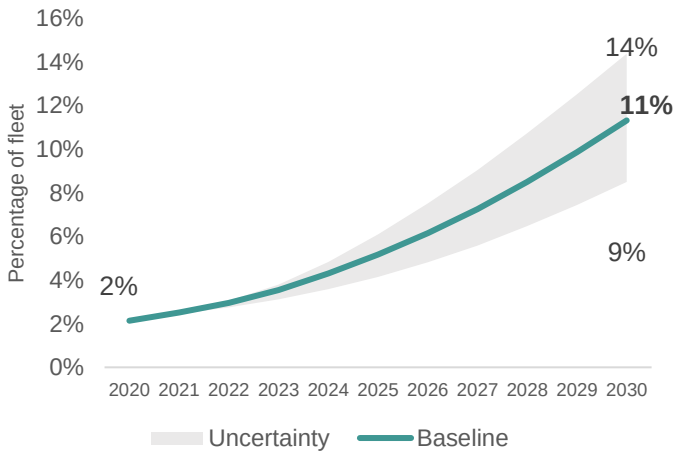
1. Introduction

The capital region of British Columbia's transportation landscape is in transition. The urgency of climate change and the imperative to create healthy, vibrant communities have brought sustainable transportation options like biking, transit, and walking to the forefront.

For remaining trips that can only be served by passenger vehicles, switching to electric vehicles (EVs) offers a significant opportunity for emission reductions. Thanks to supportive provincial, local and regional policies and incentives, and a community committed to climate action, EVs are taking off: in 2020, the region had the highest percent of EV sales in the country.[1] Capital region residents support electrification, with 93% of respondents in the 2018 CRD EV + E-Bike survey indicating it was important or very important that local or regional government promote EVs to reduce community emissions.

To support the acceleration of EVs, more investment in charging infrastructure is required. While some current and future EV drivers can plug in at home, for many drivers, access to public charging may be the only option. If the capital region's EV charging infrastructure remained as it is today, EVs are expected to reach 11% of total vehicles by 2030, which is well below many local EV targets.[2]

Figure 1: Forecast of EV Adoption Based on Current EV Infrastructure



Significant efforts are already underway to plan and invest in more charging infrastructure in the region by local governments, utilities and the private sector. Other key players are also involved in planning and deploying EV charging, such as utilities, building and landowners, large fleet owners, and EV tech and manufacturing companies.

Given the scale of investment required, the diversity of stakeholders involved, and the tight timelines to meet climate targets, deliberate and coordinated charging infrastructure investment is critical. Regional leadership is needed to support the acceleration of EV adoption in the region and address user needs, while supporting complementary priorities around affordability, equity and modal shift.

[1] Statistics Canada. (2021). *Zero-emission vehicles in British Columbia, first half of 2020*. Available online: https://www150.statcan.gc.ca/n1/pub/11-627-m/11-627-m2020076-eng.htm

Purpose

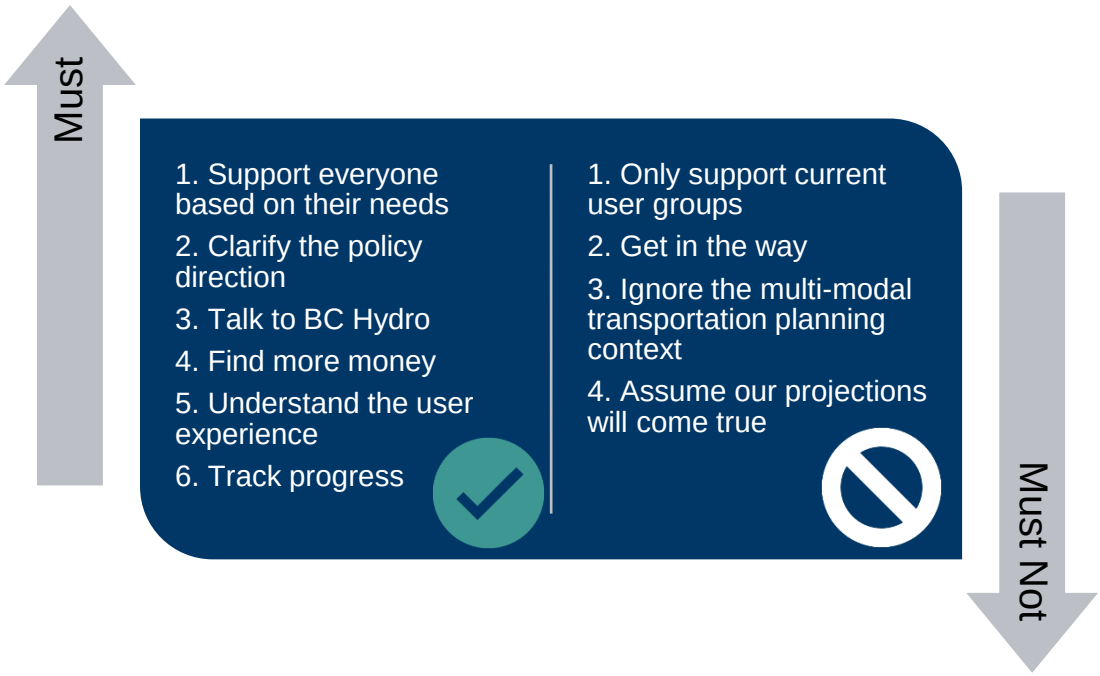
The purpose of this Roadmap is to provide:

- A high-level indication of the scale of EV charging infrastructure required to accelerate the transition to EVs in the capital region,
- An overview of the types of charging opportunities needed to support current and future EV drivers, and
- A summary of collaboration opportunities between key players and actions to support a coordinated approach to charging infrastructure deployment in the region.

The focus of this Roadmap is EV charging infrastructure for battery-electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV), given that the market is more advanced compared to other internal combustion engine alternatives. In addition, this Roadmap focuses on light-duty passenger vehicles, including those for businesses and commercial fleets within the capital region.

Guiding Principles

The Roadmap is guided by the following principles developed by stakeholders during this project's engagement process. Each opportunity has been developed to conform to these principles.



Methodology

The Roadmap was developed by engaging with regional stakeholders, modeling regional EV adoption, and incorporating the on-going work of the regional and local governments on EV policy and infrastructure. The **stakeholder engagement** process included a series of one-on-one interviews led by the CRD and two online workshops. The first defined guiding principles to ensure the Roadmap meets regional needs. The second event assessed regional collaboration opportunities. A summary of the stakeholder engagement process is presented in Appendix A.

Look out for ***stakeholder insights***

Dunsky's **Electric Vehicle Adoption (EVA) model** was used to assess EV charging infrastructure needs and costs required to accelerate regional EV adoption.

2. Current EV Charging Landscape

As of February 2021, there were 240 Level 2 and 28 Direct Current Fast Charging (DCFC) ports located across the capital region (Figure 2). Level 2 chargers are distributed widely, while DCFC ports are located primarily in Victoria, Saanich, and along major routes[3]. Detailed explanations of infrastructure types can be found in the *Capital Region Local Government Electric Vehicle (EV) + Electric Bike (E-Bike) Infrastructure Planning Guide.*

Figure 2: EV Charging Stations in the capital region (by census subdivision), February 2021

Local Government Policy and Infrastructure Plans

Local governments are taking an active role in supporting and deploying EV charging infrastructure by installing many of the charging stations across the region. Furthermore, local governments have been supporting EVs adoption more generally through their policies and planning activities. Many have identified collaboration opportunities with business, community organizations, and other local governments as an important component in public charging infrastructure funding and development in their climate and transportation plans.

Table 1 highlights EV-ready charging policies and municipal EV infrastructure plans as of March 2021.

Table 1: CRD and Local Government EV Policy and Infrastructure Plans

Government	EV Infrastructure Plan

[3] Natural Resources Canada.(2018) *Electric Charging and Alternative Fueling Stations Locator.* Available online: https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-transportation-and-alternative-fuels/electric-charging-alternative-fuelling-stationslocator-map/20487#/analyze.

City of Colwood	The City is considering 100% EV Ready requirements for multi- and single-family homes within its Parking By-law Update.
City of Langford	The City is considering an EV Ready requirement.
City of Victoria	In its 2018 Climate Leadership Plan, the City set a goal of renewable energy powering 30% of passenger vehicles by 2030. The City is currently developing its EV Strategy, which will outline its infrastructure plans. The City of Victoria has adopted 100% EV Ready standards for new multi-family and commercial buildings.
District of Central Saanich	The District outlined that one pathway to meet accelerated Climate Plan is to have 25% of vehicles on the road be zero emissions by 2030, and 100% by 2050.In its 2020 *Electric Vehicle and Electric Bike Strategy*, staff propose the installation of 3 Level 2 charging stations for public use on District properties.
District of Highlands	The District's Climate Leadership Plan outlines a vision where vehicle owners switch to zero-emission vehicles before 2030.
District of Saanich	The District's 2020 *Climate Plan* sets out to expand its municipally-owned Level 2 stations from 24 by 2025, with an interim goal in its 2020 *Electric Mobility Strategy* of 20 stations by the end of 2021. These actions aim to meet their Climate Plan target of 36% of all personal vehicles electrified by 2030, and 100% of personal and commercial vehicles are renewably powered by 2050. The District of Saanich has adopted 100% EV Ready standards for new residential, institutional, commercial and industrial buildings.
District of Sooke	The 2020 Transportation Master Plan indicates that the District has pending plans for 6 additional Level 2 charging stations, but there is no installation timeline. The *Plan* also suggests EV-Ready requirements for new residential and commercial buildings.
Town of Sidney	The Town is in the process of implementing an EV-Ready by-law for new multi-family and single-family homes.
Town of View Royal	The Town Council adopted a Zoning By-law amendment to require EV and E-bike Infrastructure residential and non-residential buildings.
Township of Esquimalt	The Township is in the process of implementing an EV-Ready by-law for new multi-family and single-family homes.
Capital Regional District	The *Capital Region Local Government Electric Vehicle (EV) + Electric Bike (E-Bike) Infrastructure Planning Guide* was developed to inform EV infrastructure planning and design in the region. The CRD also worked with AES Engineering to produce technical standards for a zoning requirement of 100% EV-ready MURB parking stalls, which facilitated a model by-law. The CRD also developed load management best practices.

Key Players

Key stakeholders for the Roadmap include senior and local governments, First Nations and other organizations that are planning and deploying EV charging infrastructure that is wholly or partially available to the public. In addition, there are industry players focused on private fleets and charging (e.g. corporate fleets, taxi companies, and development industry).

Companies involved in EV equipment, installation and engineering also play an important supporting role, such as equipment manufacturers and charging station operators. Some play a key role in supporting EVs through policy and incentives (e.g. federal government) and the EV market (e.g. vehicle manufacturers). BC Hydro is another key player, both as an owner and operator of EV charging infrastructure, as well as through their role in electricity system planning and identifying where future EV infrastructure can be accommodated.

Equity is a critical factor in public charging infrastructure by making EVs more accessible to all residents. Deliberate efforts are required to ensure the infrastructure reduces, not reinforces, inequities for people who have a low-to-moderate income[4]. For example, public charging can support residents without at-home charging or residents for whom upfront infrastructure costs are a barrier to adoption. A strong public network can enable all residents to choose electric if choosing a vehicle.

Table 2 provides an overview of the key stakeholder roles, and example organizations, in EV infrastructure deployment. Understanding and integrating these stakeholders' plans and needs is essential to developing a cohesive regional charging network. The next chapter outlines key collaboration opportunities as well as the role of the CRD in supporting a regional approach.

Table 2: Key players roles and example organizations

Key Player	Role	Example organizations
Infrastructure Builders	Actively deploying charging infrastructure	Local governments, First Nations, utilities, institutions, building developers, private companies
Site hosts	Willing to host but not necessarily own or operate infrastructure	Governments, crown corporations, First Nations, campuses, major transit hubs (e.g. ferry terminals), parking companies, retailers, fuel stations
Financial & policy supporters	Deciding or administrating EV supports	Governments, First Nations, utilities, provincial and federal governments
Utilities	Supplying electricity or building infrastructure	BC Hydro, Fortis
Technology companies	Supplying or operating charging stations or cars	Infrastructure manufacturers, EV software and data companies
Drivers	Fleet owners or EV users	Capital region residents and businesses
Ecosystem influencers	Advocate with or to industry or communities	Academia, business organizations, EV groups, NGO's

[4] ACEEE. (2021). *The State Transportation Electrification Scorecard.* Available online: https://www.aceee.org/research-report/t2101

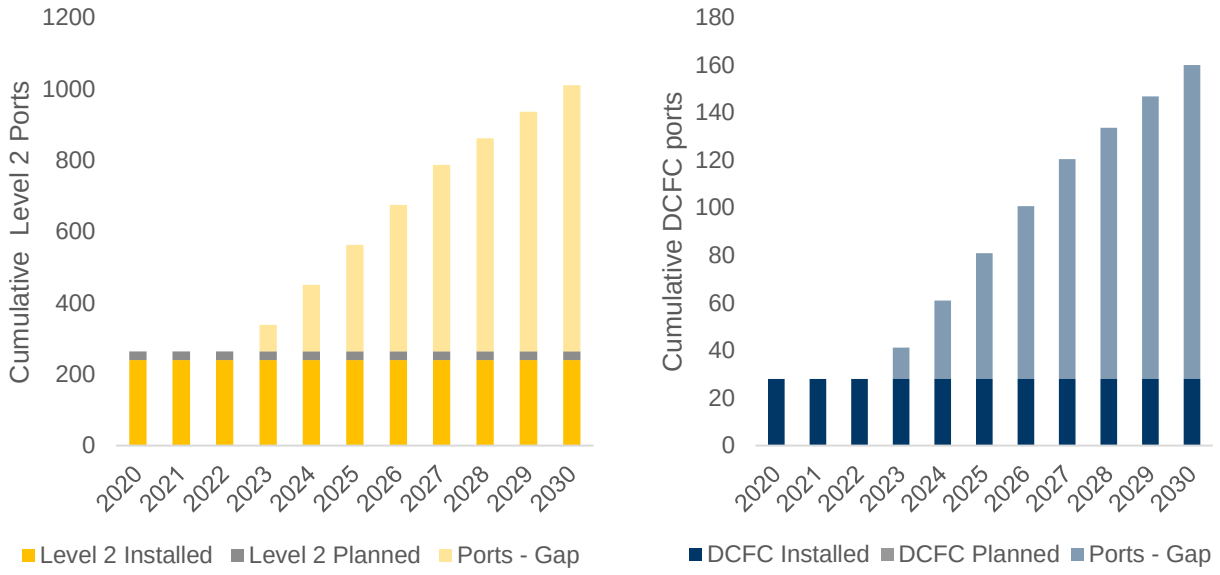
3. Regional Charging Needs

To accelerate the pace of EVs in the region and support municipal EV planning, new investment in private (e.g., at home) and public charging infrastructure is required. The following table outlines the public charging infrastructure that should be deployed by 2030 for EVs to reach 25% of the light duty fleet. This target reflects the EV adoption goals set by local governments to date, and a moderate level of ambition for the capital region.

Level 2	DCFC
770 new ports by 2030	132 new ports by 2030[5]
$7.7M total investment	$23.1M total investment

The **cumulative number of public ports** required for the capital region to accelerate EV adoption is outlined in Figure 3. The graphs show the infrastructure currently installed, the planned infrastructure that has been publicly announced, and the remaining infrastructure gap that needs to be filled. Infrastructure deployment does not start until 2023 to reflect the time required to plan, fund and execute regional charging. A detailed description of the modeling methodology is provided in Appendix C.

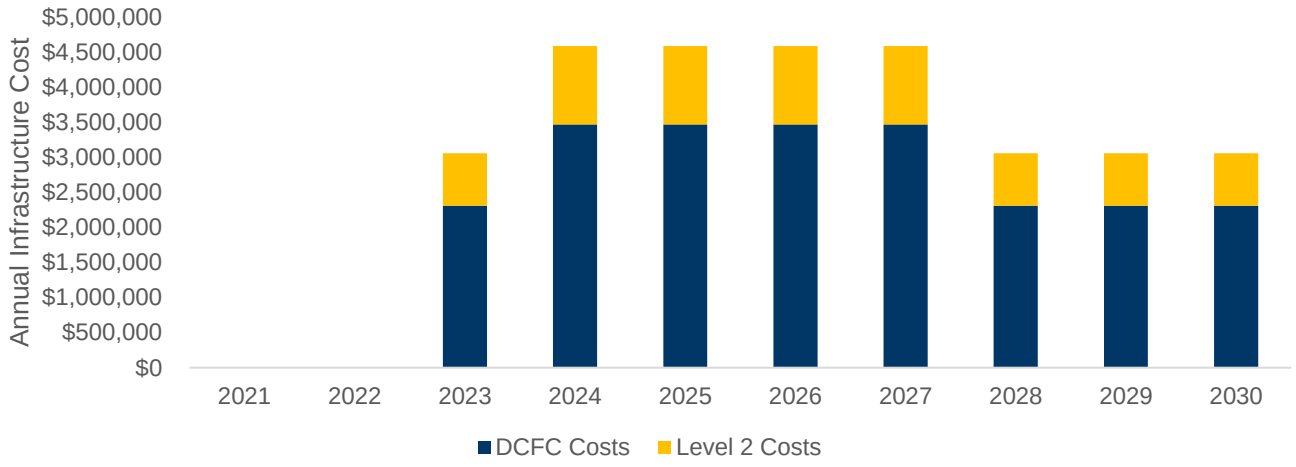
Figure 3 Cumulative infrastructure ports required to accelerate EV adoption in the capital region



[5] The DCFC port number has been updated and refined since Dunsky's 2020 *Contextual Assessment.*

The total cost to deploy the required charging infrastructure is provided in Figure 4.[6] Funding for EV infrastructure can come from both private and public sources.

Figure 4 Annual Infrastructure cost for EV infrastructure



[6] Level 2 and DCFC installations costs vary by location. Level 2 installations in parkades are assumed to be $5,000, while curbside installations are assumed to be $15,000, more expensive due to the complexity of construction in the curbside environment. The average cost used for Level 2 chargers in this analysis is assumed to be $10,000. DCFC installation costs are assumed to be $175,000 per port. Actual installed costs can vary depending on individual site conditions and the installed power capacity. Our analysis assumes an average of 150kW capacity per DCFC port.

4. Roadmap

Ensuring that EV drivers have reliable access to charging is critical to accelerating the pace of adoption. Charging at home is typically the preferred option and relies on **private** infrastructure. However, a complete and equitable charging network should provide a robust **public** charging network with **Level 2 and DCFC infrastructure** to provide options to drivers who cannot easily plug in at home, have long distances to travel, or who are looking for a quick top-up while on-the-go.

This Roadmap outlines **five charging opportunities** that consider the needs of current and future EV users:

"Match charging type with user need"

	Public Charging			Private Charging	
Charging Type	DCFC	Level 2		Level 2	
Charging Opportunity	On-the-Go	Neighbourhood	Workplace	Fleet	Home

For each charging opportunity, we provide guidance on **where and how** they should be installed, as well as technical and design needs. We identify the actions that key players can take to **collaborate** on deployment.

Private charging at home and for fleets is also a critical component of the EV charging infrastructure landscape. Workplaces may also have charging stalls for employees that are not open to the public. However, since the focus of the Roadmap is primarily on regional coordination of public charging infrastructure, we have not included infrastructure costs and targets for private charging.

A. On-the-Go

Charging type: **DCFC**
Access: **Public**

"Standards, transparency and support for potential site hosts"

"Install L3 [DCFC] chargers at locations with amenities"

	2025	2030
Cumulative New DCFC Ports Required	53	132

Charging Need Description

DCFC fast charging can support drivers traveling between communities, as well as drivers within the community who are looking for a quick top up while 'on the go.' Fast charging can be the primary option for residents without at-home charging who do not drive very far or often and as a result only need to charge up occasionally.

Location type	Technical considerations
Commuter corridors	Residents or visitors who are traveling between communities in the region may need a quick top-up while on a longer trip, similar to the way highway rest-stops offer gas station refueling with convenient access from highways. These routes could include Highway 17 or the capital region portion of the Trans-Canada
Community hubs	Fast-charging can be located in community hubs with short-stay activities or appointments. These locations could include retail, services or other short-stay locations. Six of the eight DCFC locations currently outlined in the *Capital Region Local Government Electric Vehicle (EV) + Electric Bike (E-Bike) Infrastructure Planning Guide* identified this type of short-stay, highly trafficked public spaces, including parks, libraries, and municipal halls across the region. The California Energy Commission[7] statewide infrastructure usage assessment identified that the majority of DCFC installations should be within communities where residents spend most of their time. While charging along highway corridors is crucial to enabling longer trips, fast charging sites within communities see more frequent usage. DCFC stations generally require a three-phase 480 V supply. The cost of a new electrical service for the high power necessary for DCFC hubs can vary substantially from site to site. The cost of different locations should be considered, and utilities engaged early when selecting suitable sites for DCFC hubs.

[7] California Energy Commission. (2021). *Assembly Bill 2127: Electric Vehicle Charging Infrastructure Assessment.* Accessed online: https://www.eenews.net/assets/2021/01/22/document_ew_04.pdf

Typical parking duration	Dwelling time varies, but in general, around 20-40 minutes.
Example sites	• Grocery stores, libraries, recreation centers (short stays) • Gas stations, rest stops • Retail and dining establishments
User experience and design	To make this charging opportunity attractive to EV drivers, availability and charging time needs to be reliable. Locating multiple chargers in a single hub, providing high charging power levels, as well as parking time limits or time-based usage fees to encourage turnover, can support a larger volume of EV drivers as adoption increases.
Equity	Equity is an important consideration in all charging siting, but especially due to the limited numbers of DCFC stations installed in any charging network. In addition to geographic coverage, the socio-economic conditions of the communities should be assessed when siting DCFCs to ensure equitable access. For example, DCFC ports can be distributed such that there is access across neighbourhoods and communities with varying income levels. Charge station operators should also consider the impact of usage fees on different types of users. In areas with a high percentage of MURBs where DCFC sites are intended to provide a substitute for home charging, typical DCFC usage fees would significantly reduce the opportunity for annual savings compared to a gas-powered vehicle. Alternative fee structures, such as a subscription-based monthly fee with a reduced per-session fee, may be necessary to ensure those who cannot charge at home can benefit from the same financial savings as those who can.
Operations	Due to the high cost of demand charges, the business model for on-the-go fast charging operations may not be profitable in the short-term, despite the high value they provide to the community.

Mobility Hubs

Mobility hubs, as defined in CRD's 2014 *Regional Transportation Plan*, are key locations of regional activity and regional destinations where transportation modes integrate seamlessly and efficiently, and where both the traveler environment and urban form will encourage transit, active transportation, and other alternatives to driving alone. To accommodate a diversity of transportation choice, mobility hubs include access to activity and public transport, and integrate new technologies, such as EV infrastructure. This infrastructure can support vehicle access or integration, including car share and on-the-go fast charging.

"Engage with other transit authorities (transit, ferries, etc.)"

B. Neighbourhood

Charging type: **Level 2**
Access: **Public**

"Lead with a if you build it they will come approach"

	2025	2030
Cumulative New Neighbourhood Level 2 Ports Required	158	394

Charging Need Description

Within a neighbourhood, Level 2 charging can provide an important replacement or supplement to at-home charging. Residents who do not have access to home charging may benefit from long-term (multi-hour) charging **close to home** or at **community hubs**. In the 2018 CRD EV + E-Bike public survey, access to a public charging network was described as very important to owning or purchasing an EV to 51% of respondents and important to 40% of respondents.

Location type	Technical considerations
Close to home: On-street curbside parking	Curbside charging infrastructure can be installed on residential streets using standalone, street-light based, or privately-powered electrical services. Standalone systems can be costly due to the installations requirements. Leveraging streetlighting infrastructure can help to minimize installation costs and reduce the physical footprint in the curbside environment. Streetlight systems must be evaluated for spare capacity, which may already exist or could be made available from LED retrofits. Private residence-powered systems are less common, but some jurisdictions allow them where there is no off-street space in the private lot for infrastructure (e.g. no drive-way). Electricity is fed from the residence and the homeowner owns and operates the infrastructure. This option requires clear policies on allowed uses and payment structures of privately-powered and -owned infrastructure on public curbside, which can including future infrastructure planning and multi-modal considerations.
Community hubs Public parking with longer duration parking (e.g., schools, recreation centres, parks, places of worship, etc.)	Installations can be located on curbsides or in public parking lots (either owned by the municipality or by other entities) at neighbourhood community hubs like schools and rec centres. Local government could invest in level 2 charging at local government-owned parking lots or reach agreements with the owners of privately owned lots to install local government-owned charging infrastructure. Private sector EV charging network operators can also invest in charging infrastructure at these locations, which could be supported by local governments through financial, permitting, or other support.

Typical Parking Duration	Close to Home: 8-12 hours; or Community Hubs: 1-4 hours
Example Sites	• Local services providers (e.g., recreation centres, libraries, parks) (long stay) • Institutions (e.g. schools, health care providers) • Private homeowners (if charging sites are on-street)
User experience and design	*Close to Home* Accessing EV charging close to home, ideally on the same block, can encourage residents without home charging to consider EV adoption. Residents are expected to use these chargers on a regular basis – for some it may be their primary mode of charging. The total availability of both parking spaces and charge ports relative to demand will have a significant impact on the user experience. If there is uncertainty that an EV driver will be able to access a charger when needed due to competition for parking from other users, this can impact the overall convenience of EV ownership and can impede uptake. *Community Hubs* Residents may stay parked for longer periods of time within their neighbourhood, for example when visiting parks, or recreation facilities. Residents are expected to use these chargers on an occasional basis when it is convenient to them but are less likely to rely on them as a primary means of charging. When placed in high visibility locations, these chargers can also raise awareness of EVs and public charging options. The 12 Level 2 locations outlined in the *Capital Region Local Government Electric Vehicle (EV) + Electric Bike (E-Bike) Infrastructure Planning Guide* represent this charging need. The identified locations cover recreation centres, parks, libraries, and municipal hall sites across the region.
Equity	Close to home neighbourhood charging can increase equitable access to EV ownership as it creates options for EV drivers who don't have a garage or driveway. On-street infrastructure should be focused on residential streets with lower curbside activities and demand. It is more challenging to install in urban centres or commercial areas due to the competition for on-street space from transit, active transportation, and vehicle congestion. Pedestrian and bicycle traffic flow should not be impeded by infrastructure. EV infrastructure is one element of a complete street: one which is safe, comfortable and convenient for users of all ages and abilities. The curbside design should take into account current use and any future plans (e.g. bike lanes).

Operations	Standalone systems may be costly due to the installations requirements but service can be provided in areas that rely heavily on on-street parking while ensuring equal access to any residents in the area. Once installed, stations require a dedicated party responsible for operations and maintenance, which may be provided by the municipality, the private business or homeowner where the station is located, a parking management company, or another party. The appropriate party will depend on the context of the specific installation. These stations will be accessible to the public and with high volume, and therefore may require additional maintenance than private or limited access stations. Timely and regular maintenance of the infrastructure and the site should be integrated into operation plans and budgets to ensure reliability and convenience for the user.

C. Workplace

Charging type: **Level 2**
Access: **Public**

"Do make it easy for drivers to use"

"Ensure safety on roads and lots"

	2025	2030
Cumulative New Workplace Level 2 Ports Required	141	352

Charging Need Description:

Workplace charging is an important component of the infrastructure landscape because, second to a residence, vehicles spend most of their time parked at work. This charging access can be the primary charging point that enables EV ownership, or it can supplement home charging. In the 2018 CRD EV + E-Bike public survey, at work charging was described as very important to owning or purchasing an EV to 33% of respondents and important to 39% of respondents.

Location type	Technical considerations
Public or private parkades or parking lots	Parkades likely require electrical system upgrades before infrastructure can be installed. Recent analysis by AES Engineering has determined that the most cost-effective approach for existing buildings is to perform a comprehensive EV-ready retrofit, where energized circuits are provided to parking stalls during a single renovation. EV charging stations can then be easily installed when required. Given that not all EV drivers are likely to depend on workplace charging, not every parking stall is likely to require access to charging. The appropriate target for the percentage of stalls with access to charging will vary by building type, but recent analysis suggests targets of 40% of parking stalls for areas serving as employee parking, and 15% for areas providing visitor parking. Electric vehicle energy management can minimize demand charges and building-side electrical infrastructure costs. This approach – where charging power to each vehicle is reduced during periods of high demand – can minimize electrical system upgrades and is appropriate given that vehicles are expected to stay parked for extended periods of time at the workplace.

Typical parking duration	This charging access should allow for a full charge over the typical employee shift, meaning that the vehicle would be charging between 5 to 8 hours.
Example sites	• Commercial cores with commuter parking • Academic and health care campuses • Park & Rides
User experience and design	Workplace charging includes: • **Public access:** Accessible parking in a commercial area that is open to any EV driver. Use is targeted to commuters because the chargers are in urban centres and commercial areas where workers typically park while at work. • **Limited access:** Infrastructure is only available to employees with permission, which is provided by an employer or building owner. Alternatively, some infrastructure access is limited to the employees within a building. This case supports fewer EV drivers, but the restricted access may provide more certainty of charging access to employees. Parking spaces can be reserved specifically for EV charging, and policies and related signage can be installed to clearly communicate the requirements for charger use (e.g. time limits). Reserving spaces for EV drivers ensures that costly charging infrastructure is utilised. Some users will rely on workplace charging as their primary charging source. Therefore, consistent access to charging stations will require redundancy in the station design to ensure sufficient access.
Equity	Early adopters may drive infrastructure installation in select workplaces. A range of workplace types (e.g. beyond the traditional office building) and geographic locations should be considered for support and/or guidance on charging infrastructure.
Operations	Once installed, stations require a dedicated party responsible for operations and maintenance. This service can be provided by the infrastructure builder, site host, or another party. The appropriate party will depend on the context of the specific installation.

D. Fleets

Charging type: **Level 2**
Access: **Private**

Charging Need Description

Companies and individuals operating light duty EVs for business purposes may need to develop private charging. This section addresses fleets that use private charging on public and private land. For example:

- **Companies** that use EVs in their operations, such as taxis and delivery companies, will typically deploy infrastructure at the fleet's main parking facility.
- **Round-trip carsharing** (e.g. Modo) relies on a home base for the vehicle to park – typically a reserved spot on private or public land. This designated stall creates a natural location for Level 2 infrastructure.
- **Ride sharing and ride hailing** vehicles are individually-owned without a corporate 'home base'. These vehicles rely on the private residential infrastructure of the vehicle owner.

Sometimes fleets also rely on public charging. This is addressed in the text box below.

Location type	**Technical considerations**
Fleet main parking facility	Private facilities will have unique technical considerations due to the diversity of fleet facilities and charging needs based on the fleet make-up and size. Fleets typically have a large number of vehicles charging in one facility, sometimes with similar usage patterns that can exacerbate peak charging loads. EV energy management can be crucial to ensure charging loads are managed in a way that minimizes peak demand, reducing both installation and operating costs.
On-street charging	This style of infrastructure is typically powered from dedicated power sources or by streetlights
Typical parking duration	4 to 8 hours
Example sites	• An EV fleet's main parking facility • On-street parking on public or private land with reserved dedicated parking stalls only accessible to fleet vehicles
User experience and design	Private fleets will generally rely on charging infrastructure in their own facilities and this can be designed to meet their specific needs (e.g. power levels and energy management, usage fees and/or access control). Private charging on public lands (e.g. for round-trip carsharing) needs to be balanced with other user needs and parking types.

Equity	Car sharing, ride sharing, and ride-hailing can all contribute to a mobility ecosystem that relies less heavily on personal vehicles. Cost-effective approaches to charging infrastructure (Level 2 charging instead of DCFC where possible to minimize usage fees and infrastructure costs) can help to ensure these services can transition to an electric fleet while minimizing costs and ensure these services remain affordable for community members that rely on them.
Operations	Private fleets relying on charging infrastructure in their own facilities are responsible for operations and maintenance of the charging equipment. Charging infrastructure on public lands that are intended to support private fleets (e.g. curbside Level 2 chargers for round-trip carsharing) can be installed and owned by the local government and reserved for use by a specific fleet. The fleet owner can compensate the local government through an agreement that may include usage fees. Operations can be managed similarly to other public charging infrastructure, although the agreement between the local government and the fleet may include specific requirements such as minimum response time for repairs and minimum uptime.

Public DCFC charging for fleets

In some cases, fleets will seek to utilise public charging. For example:

- While **business fleets** will generally rely on Level 2 charging infrastructure at dedicated fleet facilities, some particularly high utilization vehicle fleets may also rely on public fast charging infrastructure (e.g., taxis).
- **One-way car sharing** without dedicated parking spots (e.g. a system similar to Evo) rely on fast charging stations for top-ups since they do not typically have dedicated parking areas where Level 2 charging infrastructure can be installed.
- For **ride hailing and ride sharing**, higher than average daily driving distances can require occasional visits to a fast-charging station to have sufficient range for a full shift, especially during winter. Ride hailing drivers are likely to rely on chargers located at airports, ferry terminals, and the downtown core, given that many of their rides are expected to start or end in these locations.

Short charging times will be a priority for these users. Charging stations should aim to provide enough power to allow for a significant charge within the typical visit time.

The use of public charging infrastructure by fleets may create a need for dedicated infrastructure to ensure public stations are not overloaded. For example, in California, the high per day mileage of ride hailing drivers led to increased reliance on public charging infrastructure by these drivers as compared to personal light-duty vehicles [8]. Usage by these types of vehicles should be monitored to ensure proper levels of public access can be maintained.

[8] California Energy Commission. (2021). *Assembly Bill 2127: Electric Vehicle Charging Infrastructure Assessment.* Accessed online: https://www.eenews.net/assets/2021/01/22/document_ew_04.pdf

E. Home

Charging type: **Level 2**
Access: **Private**

Charging Need Description

Home charging is the primary charging option preferred by most EV drivers. Therefore, understanding and enabling residential infrastructure for all housing types is important in the development of an integrated regional network. In the 2018 CRD EV + E-Bike public survey, future-proofing new developments for EV charging was described as very important by 69% of respondents and important to 23% of respondents.

Dunsky estimates that the majority of **single-family dwellings** in the capital region who have home parking (e.g. a garage or driveway) could install a charging station on their own property with relatively simple and inexpensive changes to existing electrical infrastructure. Therefore, most single-family residents can manage their own charging needs. However, fifty-five percent of capital region residents live in **multi-family dwellings**, which generally require more substantial and challenging upgrades to provide access to home charging.

Location type	Technical considerations
Single-family *(garage or driveway)*	Some residents may require more extensive upgrades to electrical systems than others (including panel upgrades).
Multi-family existing buildings *(retrofits)*	Existing buildings require EV Ready retrofits to upgrade the electrical infrastructure to enable installation of charging infrastructure at parking stalls. The cost of retrofitting all stalls at once is significantly less expensive on a per stall basis than retrofitting one or two stalls at a time. EV Energy Management Systems can help to minimize the peak charging load in a building and the cost of the supporting electrical infrastructure.
Multi-family new construction	New construction offers an opportunity to ensure EV Readiness for all parking stalls, enabling charging access and future-proofing developments. 100% EV Ready policies for new construction are implemented or soon to be in some capital region municipalities. As with retrofits, costs can be minimized through the use of EV Energy Management Systems.

User experience and design	Early efforts to support EV charging in existing multi-family buildings has focused on the installation of a limited number of charger(s) to be shared by all EV residents, commonly in short-stay visitor parking. As demand increases, this approach will cause inconveniences and may limit adoption. EV Ready electrical retrofits should be installed at each stall to provide an improved user experience. For new buildings, once EV ready new construction requirements have been put in place, EV drivers will be able to seamlessly install a charging station at their parking stall and plug in with the same convenience of a driver in a single family home with a garage or driveway.
Equity	Accessing EV charging infrastructure has an additional challenge due to the limited control over the building operations and upgrades. Permission and cost-sharing will need to be discussed between the renter and landlord. Targeting rental buildings for EV Ready infrastructure support programs will support equitable access to home charging among capital region residents. In strata buildings, infrastructure planning requires discussion and clarity on of how retrofit and electrical costs are recovered.

5. Regional Collaborations & Actions

Reaching EV targets to meet climate goals requires significant investment of time and money in regional EV infrastructure. During the Roadmap development process, stakeholders indicated an interest and willingness to collaborate on building a regional network but identified a lack of clarity on who should lead EV infrastructure planning and deployment. Many organizations have a 'wait and see' approach and are looking to others to take the first step. The traditional leaders in the space, such as the provincial government and utilities, are not necessarily stepping into this role.

"Everyone wants to do it, but no one has the answers"

"Resources can't keep up with momentum"

Education and capacity building among players involved in charging deployment was also identified by stakeholders as a critical need. Within organizations, particularly local governments, new knowledge bases and skillsets are required across multiple departments to support and build EV infrastructure. However, there is limited funding to support the skills and time required to meet the ramp-up.

The CRD has an opportunity to step into the leadership gap by driving forward collaboration opportunities, working with stakeholders to create a network to share best practices, policy, and planning information and filling gaps in education tools and resources.

The CRD should focus on the following types of collaboration opportunities:

- Coordinate and financially-support a regional charging network
- Build capacity through education
- Track and share usage and user experiences to meet evolving infrastructure needs

In each collaboration, the key players are identified **in bold text**.

Collaboration Opportunities

Coordinate and financially-support a regional charging network

As described earlier in this report, a significant number of Level 2 and DCFC charging ports need to be installed over the decade to meet regional EV adoption targets. This significant ramp-up of infrastructure requires thoughtful placement of charging sites within and between capital region communities to ensure that user needs are met, and access is provided equitably across the region.

"There's a need for regional coordination"

To develop a regional network of Level 2 and DCFC, the CRD should lead a collaboration with other players including **infrastructure builders**, **site hosts**, and **EV tech companies,** who are interested in owning, hosting, and/or operating charging stations. In parallel, local governments may be actively involved in supporting and investing in charging infrastructure within their own communities. The CRD can play a critical role by taking the regional view of infrastructure planning and to use that lens to support coordination.

The key collaboration opportunities that the CRD should pursue in this area are:

1. Pursue regional infrastructure funding

There is significant funding available from the federal and provincial governments to invest in EV infrastructure, including DCFC and L2 charging. The CRD should collaborate with **local governments, infrastructure builders, ecosystem influencers** and other actors to define funding needs and pursue regional funding applications, using the Roadmap as a guideline. Where matching funds are required, the CRD and/or local governments should contribute funding to support the application.

The CRD should apply to the Natural Resources Canada (NRCan) Zero Emission Vehicle Infrastructure Program (ZEVIP) as a regional delivery agent. Funding can cover up to 50% of total costs of Level 2 and DCFC charging in public places, on-street, in multi-family residential buildings, at workplaces or for light duty vehicle fleets. In addition, the delivery organization can spend up to 15% of the funding to cover the cost of managing and delivering the ZEVIP funding.

ZEVIP's "Third Party Delivery" stream is intended to support collaboration between third party "delivery agents" and "ultimate recipients" who receive funding from the delivery agents and are responsible for the actual infrastructure deployment. CRD should apply to this fund to become a delivery agent, securing funding from NRCan and then working with local partners who would become the ultimate recipients of funding responsible for deployment of charging infrastructure. By playing this role, CRD can facilitate greater overall uptake of available NRCan funding in the region, and NRCan allows delivery agents to set their own requirements for minimum project size for ultimate recipients (direct applicants to ZEVIP's other streams must commit to a minimum of 20 ports for each application). NRCan is expected to launch a new RFP for the Third Party Delivery stream in August

2021 with applications due in November 2021[9]. The CRD should aim to submit an application in 2021, whereby confirmation from NRCan would be provided in early 2022, and CRD could begin working with local partners to apply as ultimate recipients.

The BC government has partnered with NRCan to provide additional funding for DCFC projects deployed through ZEVIP for an additional 25% of project costs. Successful applicants to NRCan's program are automatically eligible for funding from the Government of British Columbia. Separately, the CleanBC Go Electric Public Charger Program also offers funding for the deployment of public fast charging infrastructure, although this program is not eligible for stacking with NRCan's program.

2. Support planning and coordination on site selection

Currently, site selection and planning are fragmented and pursued by various actors in silos. This creates a risk of duplication of efforts and gaps in infrastructure deployment, including geographic distribution, charging type and number of chargers required to meet targets. In addition, there is no formal process or structure for infrastructure builders to connect with potential site hosts. Using the CRD Roadmap as a guideline for how many and what types of charging stations are required to support user needs, the **CRD** should collaborate with **local governments**, **site hosts and EV infrastructure builders** to support planning and coordination on site selection.

This could include identifying and working with potential site hosts to develop EV infrastructure plans or form partnerships with EV infrastructure builders. The CRD should focus on strategic site hosts, for example those that have locations across the region or serve as major transportation hubs (e.g. ferry terminals). By playing this role, the CRD can accelerate EV infrastructure deployment, help build knowledge and capacity across the region, and reduce the risk that infrastructure gaps will emerge. For example, the CRD and local governments could provide financial or other support to encourage charging infrastructure in locations with poor business cases but high value due to geographic or equity factors.

To support this collaboration, the CRD should consider establishing an advisory committee or other formal network that would include key players such as local governments, infrastructure builders and site hosts. As part of this network, the CRD could support the site selection and planning process and address current information gaps in EV infrastructure planning by tracking and sharing information related to:

- Planned charging infrastructure in the capital region;
- Infrastructure builders looking for site hosts; and
- Prospective site hosts, including on-street and MURBs, who have expressed an interest in hosting charging infrastructure (but not deploying it)

[9] Timeline of expected future RFP's under NRCan's ZEVIP: https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-transportation-alternative-fuels/electric-and-alternative-fuel-infrastructure/request-for-proposals-calendar/22821

3. Engage with BC Hydro on infrastructure planning

BC Hydro has an important role to play in EV infrastructure collaborations. As an EV infrastructure builder, BC Hydro's mandate is to focus on filling gaps in DCFC fast charging across the province and support regional connectivity. BC Hydro also has a key role in planning the regional charging network because collaborators will seek guidance on potential sites, power demand considerations, and rate structures that enable strong business cases.

The **CRD** should collaborate with **BC Hydro** to highlight and address the needs of **infrastructure builders** and **local governments**, including power capacity, rate structure, and utility infrastructure plans. The CRD can work with regional stakeholders, particularly the leading local governments, to bring regional needs to the utility.

Build capacity through education

"People are looking for best practices"

Education and capacity building among players involved in charging deployment is a critical need. EV infrastructure can be a complex process for residents, businesses, contractors and trades. There is a major opportunity to build capacity across the region to enable any interested party to participate in transportation electrification and the EV infrastructure industry that develops alongside. The CRD can play an important role by acting as a central resource that can leverage best practices tested across the region and avoid duplication. While each community is unique, residents and business will have some common questions, and the CRD can develop regional resources that can be locally adapted.

The CRD should also engage with provincial actors such as BC Hydro and Plug-in BC to coordinate and develop shared education and capacity building materials.

These opportunities include:

4. Education and capacity building with potential EV adopters

Many residents and businesses may be considering EVs, but may not know how to get charging installed at their home or workplace, especially in rental or condo buildings. This group includes employees, homeowners and tenants. The **CRD** and **local governments** can collaborate with **EV ecosystem influencers** and **EV tech companies** to develop educational materials and resources for enable these potential adopters to navigate their infrastructure needs, enabling better adopter advocacy, and increase ease of infrastructure access.

5. Education and capacity building with potential infrastructure builders and site hosts

Regional businesses and organizations may be interested in developing or hosting EV infrastructure. However, for organizations like property management companies, fleet owners and large employers, building EV infrastructure is outside of their expertise. These actors would benefit from capacity building and education on the benefits and the process to seek infrastructure as a site host. The **CRD** should collaborate with **local governments, infrastructure builders** and **EV tech companies** to

develop resources on charging needs and site selection to ensure this interest can be converted in new infrastructure development.

6. Education and capacity building with engineers, electricians, and other trades

There is significant opportunity to grow the workforce involved with this ramp-up of EV infrastructure deployment. As the industry grows to meet the demand, there is an opportunity build the capacities on the technical and design requirements for EV infrastructure across the construction industry. The **CRD** should collaborate with industry, **infrastructure builders, EV technology companies** and **local governments** to encourage or develop guidance and educational materials to ensure quality and reliability across diverse installation sites. Industry stakeholders may develop standards or best practices to support the nascent sector.

Track and share usage and user experiences to meet evolving infrastructure needs

Building out infrastructure is essential to promoting adoption. In early years, charger utilization may be low as infrastructure installations initially outpace demand. Charger utilization is expected to increase over time as adoption and EV driver awareness grows. Infrastructure build out should be informed by regional needs and trends. Leveraging infrastructure data can support future siting and design decisions, to continuously assess and improve the regional network.

"Data integration and information access"

7. Track and share usage at existing sites to monitor performance and inform planning

The **CRD** should facilitate data sharing by acting as regional data repository and defining data needs needed to benchmark the Roadmap. In addition, the CRD should lead or support analysis and share findings to support future infrastructure site planning and design decisions and best practices. Data collection and use is a collaboration because it requires the data owners, whether it be **infrastructure builders, site hosts, EV tech companies**, or **utilities**, to share the data and to design stations to facilitate sharing (e.g. networked stations).

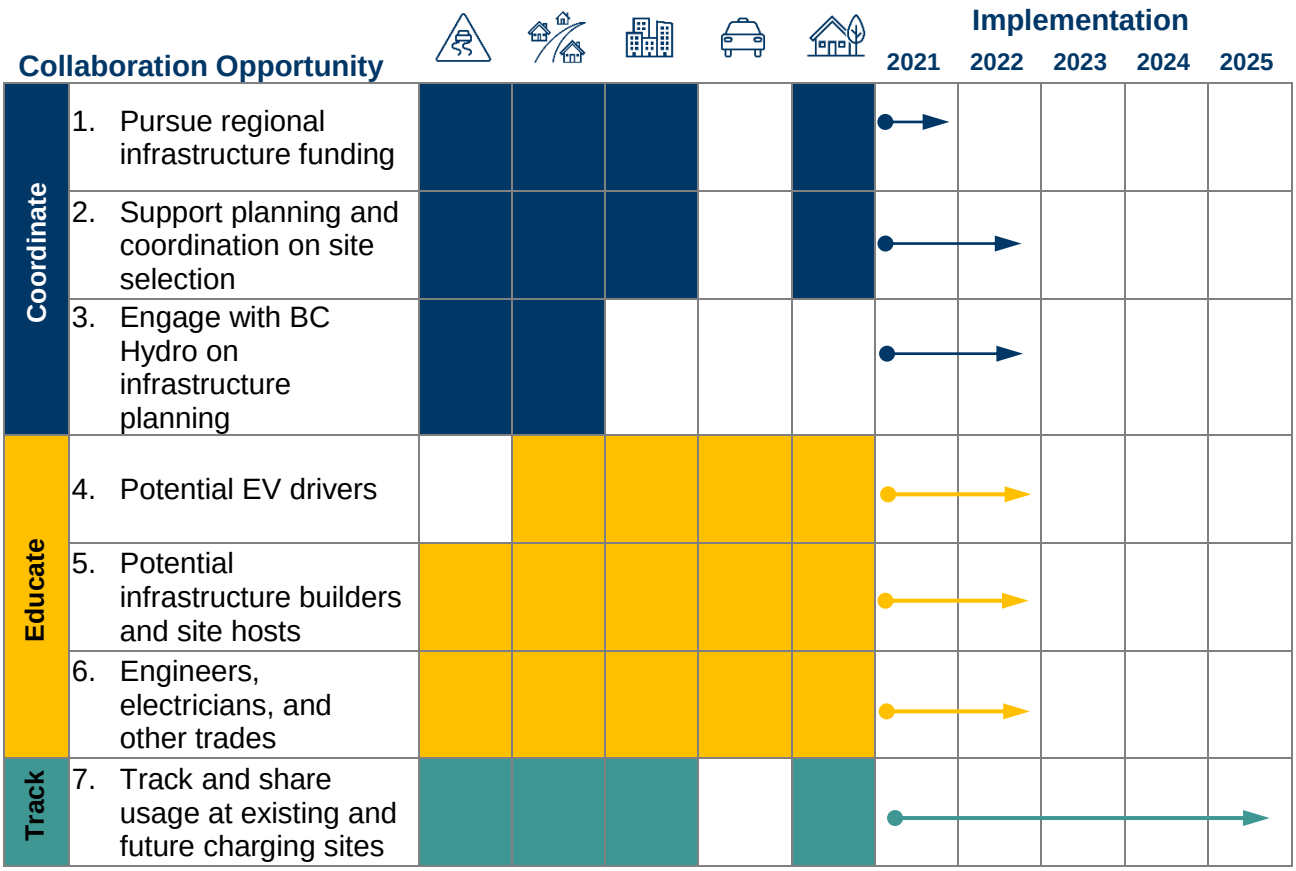
Types of data that should be collected by CRD and regional collaborators includes:

- Site locations, date of installation, port types
- Number of MURB units with EV-Ready spots
- Number of EV-Ready commercial buildings
- For public charging sites, utilization metrics:
    - Total number of charge events and total energy delivered
    - Time-of-use statistics (usage by day of week, hour of day)
- EV adoption metrics: percent of new vehicle sales, percent of fleet, percentage of BEVs vs PHEVs.
- User experience metrics, including trends in timing and geographic use of public infrastructure

The CRD should also explore the option to enhance data collection by conducting a regular (annual or semi-annual) EV user survey to get feedback on wait time, reliability, and convenience of charging locations to inform future infrastructure deployment.

Summary of Regional Collaboration Opportunities

The following chart provides a summary of collaboration opportunities. It identifies the relevant charging opportunities that it supports, as well as the implementation timeline.



Collectively, these actions will support infrastructure deployment across the region. The CRD can take a leadership role by taking a regional perspective and ensuring that deployment planning and siting is coordinated, that education is minimized as a barrier to infrastructure deployment, and that a 'systems' approach is taken to infrastructure usage and data across the whole region, for benefit of all.

Actions

There are key actions that the CRD should take to develop the guidance needed to support local governments and other EV infrastructure players to build out a connected and coordinated regional infrastructure network. While infrastructure actors can provide input, the CRD can independently lead the development of these tools and resources to support regional infrastructure efforts. Alternatively, the CRD could advocate for provincial actors such as BC Hydro or the province to undertake these guidelines to ensure that local governments across B.C. can benefit.

In addition, there are a number of actions that local governments should take to accelerate infrastructure deployment, including planning for and investing in charging infrastructure. Local governments can play varying roles, including hosting, owning, and operating charging stations. Local governments can also introduce or expand EV-Ready requirements for EV ready new construction and support for comprehensive retrofits to shift the market to support an EV network.

The CRD should develop the following guidelines and/or technical standards to address information gaps and encourage consistency across the capital region. Guidelines should be revisited every five years, or more frequently as the regional context evolves. For example, the CRD developed load management guidelines, which should be reviewed and updated in the next several years as technologies evolve.

A. Comprehensive EV Ready retrofits

These guidelines and standards enable local governments and other stakeholders to navigate the process, requirements, and value of comprehensive EV-Ready retrofits.

B. Curbside installations

On-street charging presents a unique opportunity and challenge due to the specified use of this public, multi-use space. Guidelines with regional context can enable local governments and infrastructure builders to navigate the process and ensure long-term, equitable planning in the development process.

C. Site Agreements between charging hosts and owners

Site agreements are critical tools to define how infrastructure collaborations work because they define responsibilities of each actor and define the site access. The **CRD** should develop templates or best practices for site agreements to support the negotiation process.

D. Data sharing, user experience, infrastructure deployment

BC Hydro has developed valuable guidelines to support organizations in the deployment of both DCFC and Level 2 charging infrastructure[10], providing guidance on identifying charging sites, designing the installation, selecting contractors and vendors, and operation and maintenance of

[10] BC Hydro. (2021). *EV resources for industry*. Available online: https://www.bchydro.com/powersmart/electric-vehicles/industry.html

charging equipment. The CRD can build on these documents by establishing regional guidelines to encourage local partners to converge towards common design elements. For example, while the BC Hydro guidelines present a wide variety of options for charging equipment vendors and customer interfaces, the CRD can encourage local partners to agree on a harmonized payment system to ensure that EV drivers in the capital region have a consistent user experience from one charging station to the next. These guidelines can also establish requirements for data collection and sharing for local partners to support ongoing tracking of the regional charging network.

Summary of Actions

The following is a summary of actions that the CRD should pursue in the near term to support EV deployment in the capital region.

Guidelines for:					
A. Comprehensive EV Ready retrofits					
B. Curbside installations					
C. Site Agreements between charging hosts and owners					
D. Data sharing, user experience, infrastructure deployment					

Appendix A. Stakeholder Engagement Summary

Overview

The core focus of the CRD's EV Roadmap is to identify collaboration opportunities to ensure the effective deployment of charging infrastructure in the capital region. Therefore, engaging with stakeholders to understand various actors' interests, needs, and plans for EV infrastructure was a critical part of the Roadmap's development. The CRD led the stakeholder engagement strategy and implementation with support from Dunsky.

This memo summarizes the key themes and takeaways from the two workshops that Dunsky supported. The CRD also held a series of in depth one on one interviews with key stakeholders to gain initial insights. Dunsky will present the final results of the Roadmap in a webinar on March 30. The list of stakeholder organizations is presented in Appendix A.

Our stakeholder engagement plan was structured around four phases:

For each of these phases, we answered the following questions:

- **Participants**: Who is targeted by / included in the engagement strategy?
- **Approach**: When and how groups will be engaged (e.g. format and timing of meetings)
- **Objective**: Why is this group engaged, what are the expected outcomes?

Workshop 1: Developing the Roadmap's Guiding Principles

Feb 4

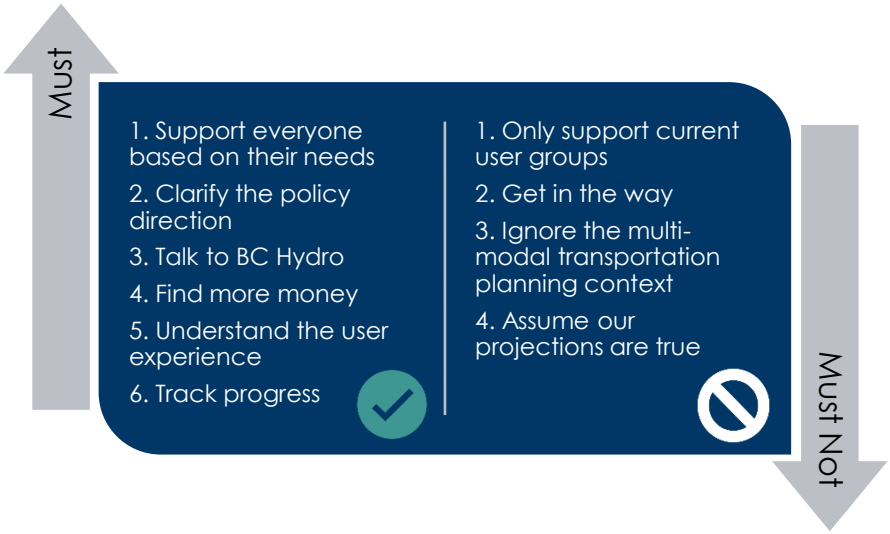
35 Participants
Target: **Infrastructure influencers, builders, & users**
CRD members, provincial government, utilities, institutions, EV and transportation companies, NGOs

Mural, Zoom

Identify the principles by which the Roadmap will be developed.

Key Findings

The main takeaway was the principles that define the Roadmap. These ten principles were developed through the workshop and summarized by Matt Greeno. These principles have and continue to be used to create the Roadmap and shape its recommendations.



As identified in the principles, several key themes emerged:

1. Ensure a data-driven approach

Data should drive decisions in EV infrastructure planning and deployment. Stakeholders highlighted that there is little data available right now and that it will be critical for informed decision-making, defining collaboration opportunities and understanding the region's evolving activity and needs. For example, current EV charging station usage and electricity system capacity to support new infrastructure.

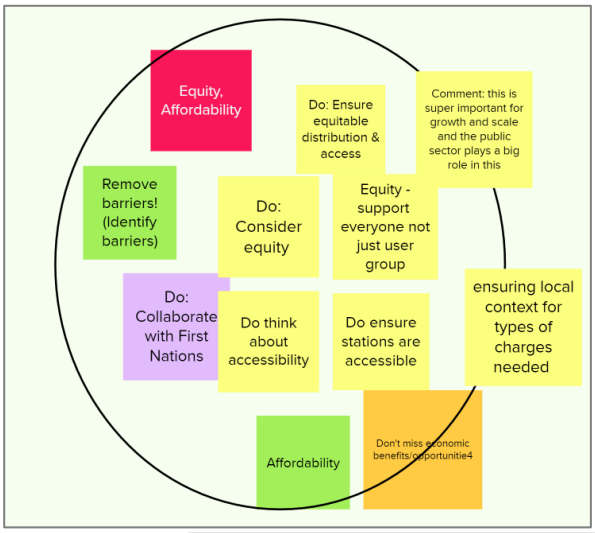
2. An equity lens needed

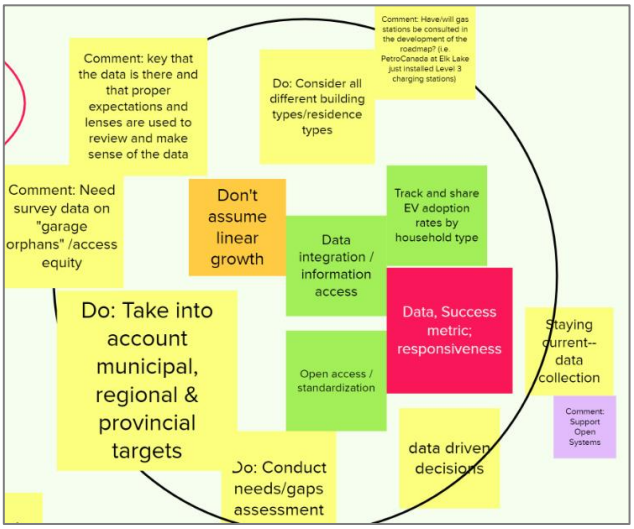
To be successful and gain broad support, stakeholders identified the need to apply an equity lens to infrastructure decisions. This approach will ensure user needs are met (e.g., accessibility, affordability) and that all communities are covered.

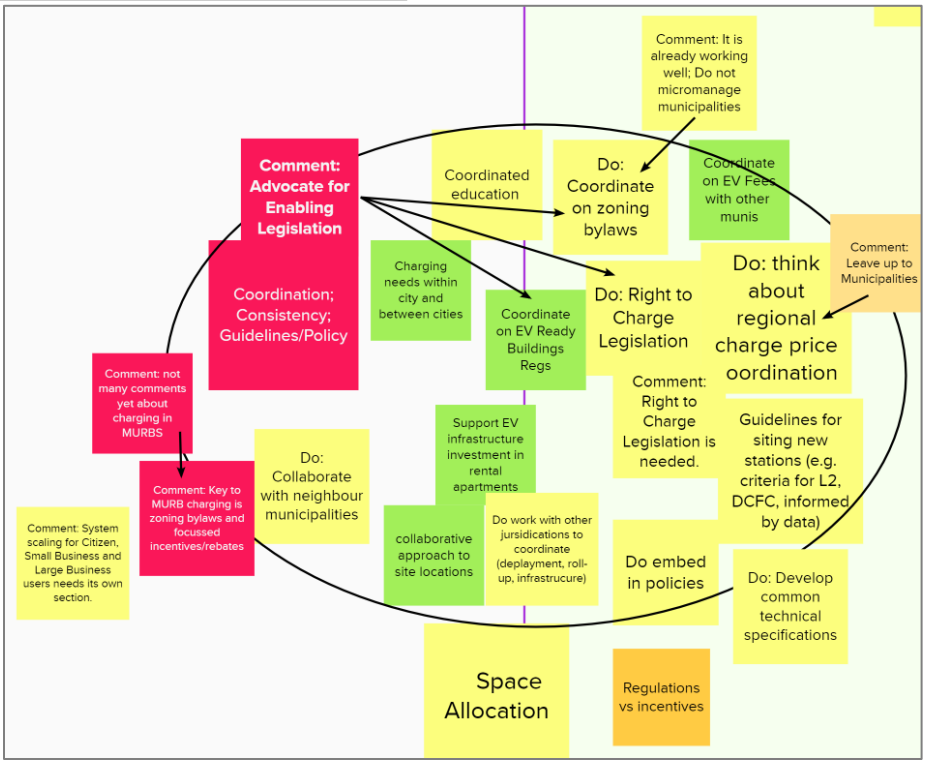
3. A supportive, but not prescriptive, policy landscape

Stakeholders indicated that they need supportive policy and policy supports from all levels of government. At the municipal level, sharing best practices and technical specifications can help move the region forward. However, each local government wants to determine their own policies and infrastructure plans.

Stakeholders expressed their views on guiding principles through an exercise on Mural, an online visual collaboration tool. Here are a few snapshots of sticky notes added to the mural:







Workshop #2: EV Charging Needs and Collaboration Opportunities

Mar 1

17 Participants
Target: **Infrastructure influencers and builders**
CRD members, institutions, school districts, EV and transportation companies

Mural, Zoom

Explore and identify **collaboration opportunities** for public EV infrastructure deployment.

Key Findings

The core exercise was to surface interdependencies by making clear requests to other stakeholders and collecting simple responses ("Yes", "No", "I will try", or "whatever" indicating the request was not clear enough to respond). The majority of responses are positive, either "Yes" or "I will try", indicating a broad willingness to collaborate and meet the needs of other stakeholders. However, not all desired stakeholder groups were represented at the session, which limited the applicability of some requests/responses.

1. An infrastructure leadership gap exists

Stakeholders identified that there was a lack a leadership on EV infrastructure planning and deployment. Many organizations have a 'wait and see' approach and look for others to take the first step. The traditional leaders in the space, such as the provincial government and utilities, are not necessarily stepping into this role. This gap presents an opportunity for the CRD to provide regional leadership.

"Everyone wants to do it, but no one has the answers"

2. Capacity building is required

Education and capacity building among players involved in charging deployment is a critical need. Within organizations, particularly local governments, new knowledge bases and skillsets are required across multiple departments to support and build EV infrastructure. Staff time and resources are needed across organizations to facilitate collaboration, recognizing that different organizations are at different stages. This capacity gap has been identified, but there is limited funding to support the skills and time allocation to meet the ramp-up.

Stakeholders identified a need for regional guidance and other resources to cross the capacity gap. This resource discussion included the following concepts:

"Resources can't keep up with momentum"

- A network to share best practices, policy, and planning information, collaboration opportunities. This network could address silos between infrastructure stakeholders across the region.
- Actor-specific guidance on assessing infrastructure opportunities. This guidance would ensure infrastructure aligns with site and user needs (e.g. why are we building it and who is it for?). This guidance could be tailored by the stakeholder's general role and mandate. For example, a school district's infrastructure decisions will look different from those of a local government.
- A holistic approach to transportation decisions. Active transportation, transit, and EV's are not either-or options but rather all part of the transportation ecosystem.

3. A strong interest was expressed in collaboration and clarified roles

Stakeholders identified EV infrastructure deployment is a new an innovative field. While there is a lot of enthusiasm to collaborate, there is not a lot of experience with roles, responsibilities and deployment approaches, making collaboration opportunities more challenging.

"Innovation / turnkey solutions - make the process easier and reduce costs."

To tackle these challenges, stakeholders identified the following concepts:

- Guidance on potential collaboration roles: outlining business models and the roles within them (e.g., who builds, who pays, who operates, etc.).
- Develop a list of businesses and their potential sites interested in being a site host.
- Encouragement to current infrastructure leaders and to spur demand by developing a list of EV-Ready stratas and businesses.

Key themes were identified through an idea board and are noted in the following screenshot:

Stakeholder List

The following stakeholders were engaged during the development of this Roadmap. We sincerely thank them for their input and collaboration.

Organizations interviewed prior to workshops	
BC Ferries	Landlord BC
BC Hydro	Malahat Nation
BC Transit	Modo
Geotab	Robbins Parking
Hansbraun Investments	University of Victoria
Island Health	Westshore Town Centre

Organizations represented at the February 4 workshop	
BC Climate Action	Greater Victoria Harbour Authority
BC Ferries	Greenlots
BC Hydro	Island Health
BC Transit	Leading Ahead Energy
BCSEA	Landlord BC
Capital Regional District	Malahat Nation
ChargePoint	Mogiletech
City of Victoria	Plug n' Drive
Current Taxi	Suncor EnergyTesla
District of Central Saanich	Township of Esquimalt
District of Highlands	Transition Salt Spring
District of Oak Bay	University of Victoria
District of Saanich	Vancouver Island Strata Owners Association
Geotab	Victoria EV Association
Government of British Columbia	

Organizations represented at the March 1 workshop	
Capital Regional District	School District 61
Chargepoint	School District 62
City of Victoria	School District 63
District of Central Saanich	Town of Sidney
District of Saanich	Town of View Royal
Greenlots	Township of Esquimalt
Island Health	University of Victoria
Modo	

Appendix B. Funding Opportunities

Fund Name	Technology	Support Available	Eligible organizations
CleanBC Go Electric Public Charger Program	DCFC	Range: up to $20,000 per <50 kW DCFC, to $130,000 per >100 kW DCFC (for Indigenous communities).	business, not-for-profit, local government, Indigenous community, or public sector organizations
CleanBC Go Electric Public Charger Program	Level 2	up to 50% of purchase and installation costs of Level 2 charging stations (to a maximum of $2,000 per station). Indigenous communities are eligible for rebates of 75% (to a maximum of $4,500). Five hours of an EV advisor for advice and planning assistance from an expert in EV charging and equipment is also available	business, not-for-profit, local government, Indigenous community, or public sector organizations
CleanBC Go Electric Fleets Program	Level 2	zero emissions vehicle fleet advisor support and ZEV training sessions along with financial rebates for fleet assessments, electrical assessments, electrical work, and charging infrastructure	companies registered in B.C, non-profit organizations, and public entities.
CleanBC Go Electric BC Single-Family Home Charging Installation	Level 2	up to 50% of costs, to a maximum of $350.	Single family homes
CleanBC Go Electric BC EV Charger Rebate	Level 2	• For buildings looking to become EV Ready, up to $3,000 or 75% of costs to prepare EV Ready plan by a licensed professional. To implement, buildings can receive a rebate of up to 50% of the infrastructure and installation costs to a maximum of $600 per stall (total maximum of $80,000). Once EV-Ready, there is a rebate of up to 50% to a maximum of $1,400 per charger (and a building maximum of $14,000). • For buildings or individuals looking to install standalone chargers, up to 50%, to a maximum of $2,000 per charging (and a building maximum of $14,000)	Multi-family buildings

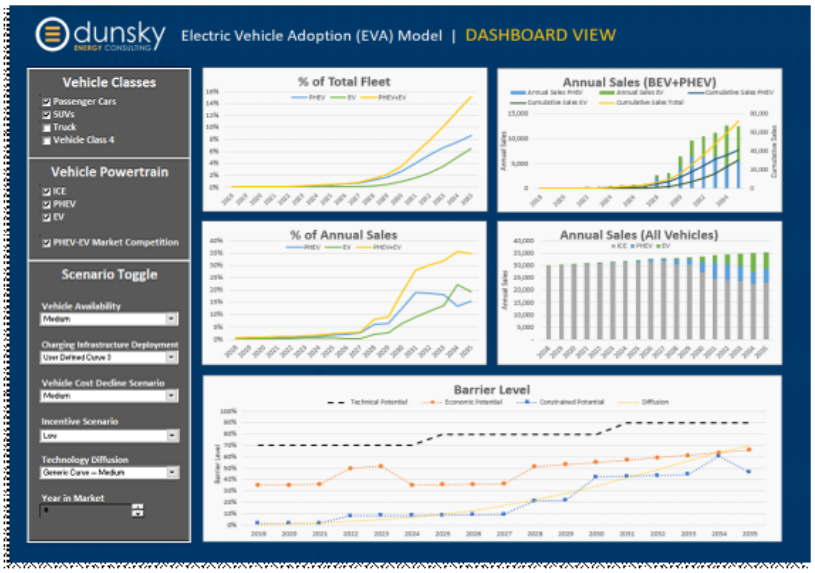
		• Five hours of an EV advisor for advice and planning assistance from an expert in EV charging and equipment is also available.	
Natural Resources Canada Zero Emission Vehicle Infrastructure Program	DCFC	of up to 50% of total project costs , to a maximum of $15,000 per fast-charger for 20kW to 49kW, and up to 50% of total project costs, to a maximum of $50,000 per fast-charger for 50kW and above.	not-for-profit and for-profit organizations
Natural Resources Canada Zero Emission Vehicle Infrastructure Program	Level 2	up to 50% of total project costs, to a maximum of $5,000 per Level 2 connector.	not-for-profit and for-profit organizations with funding for on-street and public places and workplaces, including fleets, multi-family buildings

Appendix C. Modelling Approach

EVA Methodology

Dunsky's Electric Vehicle Adoption (EVA) Model was developed in-house to address a growing need to understand the adoption of electric vehicles in specific jurisdictions. Based on a rigorous review of research from academia and industry, EVA assesses the likely penetration of electric vehicle technology based on several key factors, grouped according to the following four categories:

A. **Technical potential:** The theoretical potential for EV adoption based on the size and composition of the overall vehicle market, as well as availability of different powertrain types (e.g. plug-in hybrid, battery electric) in different vehicle classes (e.g. cars, SUVs, trucks)



Sample EVA Dashboard View

B. **Customer economics:** The unconstrained economic potential based on incremental total cost of ownership of electric vehicles over conventional vehicles, taking into account forecasted energy costs, annual vehicle kilometers travelled, and forecasted battery and vehicle costs

C. **Market constraints:** Accounting for EV-specific barriers including range limitations and access to both public and home charging infrastructure

D. Market dynamics: Incorporating technology diffusion theory and other market factors to determine rate of adoption and competition between vehicle types

By quantifying the impact of these various factors, EVA allows the development of jurisdiction-specific forecasts for EV adoption and the assessment of the relative effectiveness of a range of policy and program options for accelerating EV adoption, such as home retrofits and public charging infrastructure deployment.

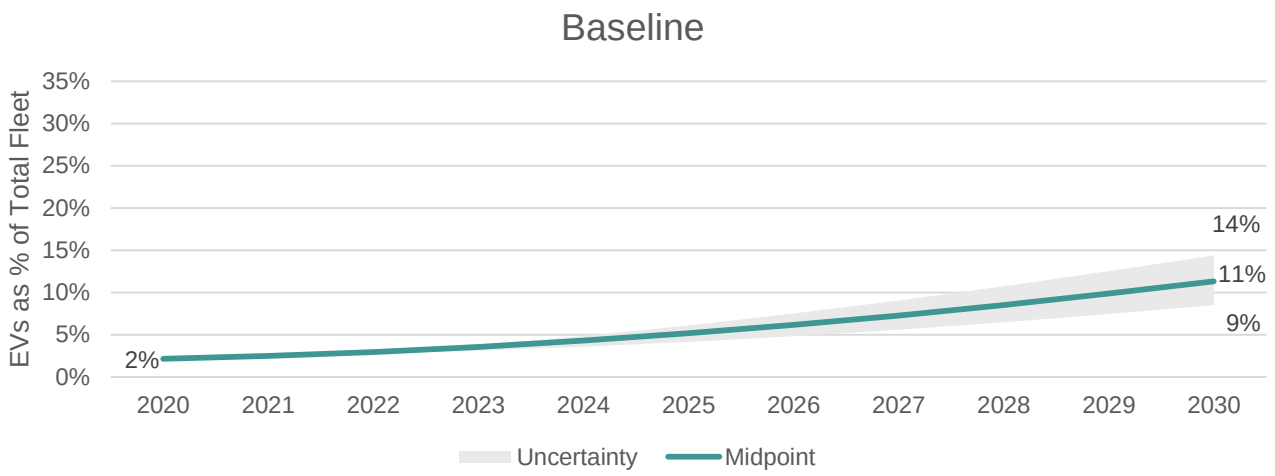
High-Level Results

This study assessed EV adoption in the capital region over the 2021-2030 period and the infrastructure required to support this adoption. First, a baseline forecast was developed to estimate adoption in the absence of further charging infrastructure investments and supporting policies. Next, a scenario forecast was developed by adding public charging infrastructure and increased home charging access to the model such that the adoption forecast reached approximately one quarter of the total vehicle fleet by 2030. The charging infrastructure required to reach this target is the basis for the infrastructure recommendations included in this roadmap.

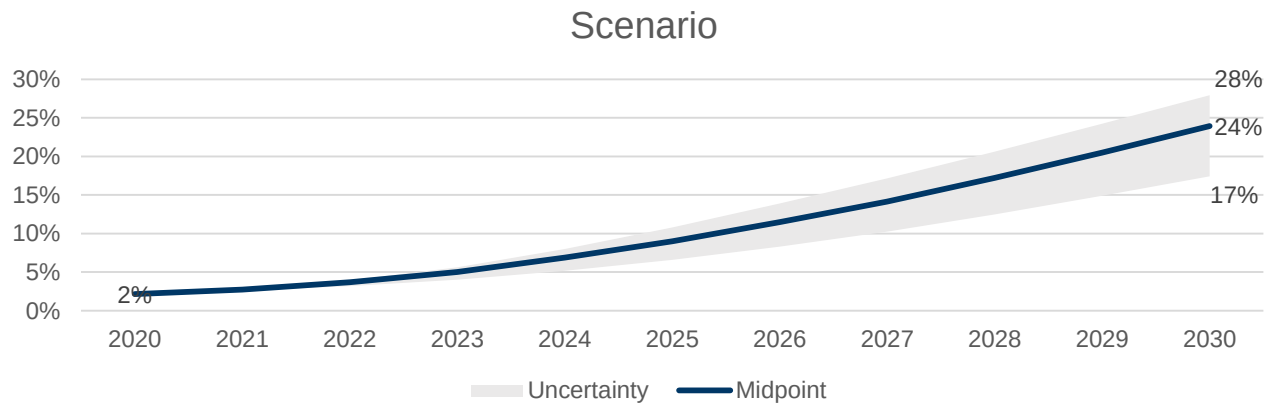
This study includes an aspirational target that approximately one quarter of the light-duty vehicles in the capital region will be EVs by 2030 (with adoption ranging from 17-28%, with a midpoint of 24%). Our modelling shows that this corresponds to a trajectory reaching an annual midpoint EV sales rate of 68% in 2030, which is considerably higher than the provincial government target of 30%. Although the focus of this project was on the public infrastructure required to support this adoption in the capital region, other policies and programs will also be required. The modeling includes the assumptions that upfront purchase incentives are sustained throughout the course of the study (albeit at decreasing levels over time), and that home charging access increases over time as a result of financial and other support for multi-unit home charging retrofits (see 'Other Program and Policy Assumptions' section below). The costs associated with incentives and home charging retrofits are not included in this analysis.

Adoption is also influenced by broader market conditions, including vehicle prices, vehicle model availability, electricity rates, and gasoline prices. In both the baseline and scenario forecasts, high and low bounds were developed for each of these factors and were applied to the scenario to generate a range of uncertainty around the forecast.

Below, high-level results are provided for the baseline and scenario forecasts. Detailed results are provided in the Detailed Adoption Results section that follows.



		2025	2030
% Annual Sales	Baseline – Upper bound	25%	37%
	Baseline – Midpoint	17%	29%
	Baseline – Lower bound	12%	21%
	Provincial target	10%	30%



		2025	2030
% Annual Sales	Scenario – Upper bound	54%	74%
	Scenario – Midpoint	42%	68%
	Scenario – Lower bound	28%	50%
	Provincial target	10%	30%

Market Assumptions

Vehicle Assumptions

Vehicle Market Total Fleet and New Sales Assumptions[11]

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cars	Total fleet	144,483	143,261	141,950	140,549	139,059	137,480	135,811	134,053	132,206	130,269
	New sales	6,498	6,443	6,384	6,321	6,254	6,183	6,108	6,029	5,946	5,859
SUVs	Total fleet	84,577	88,352	92,198	96,115	100,104	104,165	108,297	112,500	116,775	121,121
	New sales	4,840	5,056	5,276	5,500	5,729	5,961	6,197	6,438	6,683	6,931
Trucks	Total fleet	41,353	42,579	43,822	45,084	46,363	47,660	48,975	50,308	51,659	53,028
	New sales	2,873	2,958	3,045	3,132	3,221	3,311	3,403	3,495	3,589	3,684

Electricity and Fuel Price Assumptions

Electricity Price Assumptions ($/kWh)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
High	0.122	0.125	0.128	0.132	0.135	0.138	0.142	0.146	0.149	0.153
Mid	0.123	0.127	0.130	0.134	0.138	0.142	0.145	0.149	0.154	0.158
Low	0.124	0.128	0.131	0.135	0.139	0.143	0.147	0.152	0.156	0.161

Gasoline Price Assumptions ($/L)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
High	$1.13	$1.16	$1.17	$1.18	$1.19	$1.21	$1.23	$1.25	$1.27	$1.29
Mid	$1.36	$1.38	$1.40	$1.42	$1.44	$1.46	$1.48	$1.51	$1.54	$1.56
Low	$1.58	$1.62	$1.66	$1.69	$1.70	$1.72	$1.74	$1.78	$1.81	$1.83

Building Stock Assumptions[12]

Forecasted Number of Dwelling Units by Housing Type

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Single detached	70,693	70,709	70,725	70,741	70,757	70,773	70,789	70,804	70,820	70,836
Semi-detached	7,195	7,368	7,546	7,728	7,915	8,106	8,301	8,502	8,707	8,917
Row	11,043	11,216	11,391	11,568	11,749	11,932	12,118	12,308	12,500	12,695
Apartment and other	89,282	91,035	92,823	94,646	96,505	98,400	100,332	102,302	104,311	106,360

Forecasted Cumulative New Construction Units by Housing Type

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030

[11] Total light duty vehicle forecasts were provided by the CRD. To capture the split of cars, SUVs, and trucks within the light-duty vehicle population, historic 2017-2019 ICBC registration data market share trends were extrapolated out over the study period. Annual sales were forecasted using province-wide sales as a percent of fleet data from the Canadian comprehensive energy use database.

[12] To forecast the building stock, growth rate trends were taken from the 2011 and 2016 census. The rate of new construction (as a percent of existing buildings) was developed using the CMHC 'Housing Starts, Completions and Units Under Construction' publication.

Single detached	317	633	950	1,267	1,584	1,901	2,218	2,535	2,852	3,169
Semi-detached	73	148	224	302	383	465	549	635	723	814
Row	51	103	156	209	264	319	375	432	490	548
Apartment and other	1,275	2,575	3,900	5,252	6,630	8,035	9,468	10,929	12,418	13,937

Infrastructure Assumptions

Infrastructure Targets (Cumulative Ports)

	Level 2		DCFC	
	2025	**2030**	**2025**	**2030**
Infrastructure Required	562	1010	81	160
Installed	240	240	28	28
Planned	24	24	0	0
Total Gap	298	746	53	132

Level 2 Charging Infrastructure Assumptions (Number of Ports)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Baseline	240	240	240	240	240	240	240	240	240	240
Scenario	240	240	339	451	562	674	786	861	935	1010

DCFC Charging Infrastructure Assumptions (Number of Ports)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Baseline	28	28	28	28	28	28	28	28	28	28
Scenario	28	28	41	61	81	101	120	134	147	160

Infrastructure Cost Assumptions

Level 2 curbside ($ per port)	$15,000
Level 2 in parkade ($ per port)	$5,000
DCFC ($ per port)	$175,000

Other Program and Policy Assumptions

Upfront Vehicle Purchase Incentive Assumptions (combined federal and provincial)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
PHEV	$5,000	$5,000	$5,000	$5,000	$5,000	$2,500	$2,500	$1,250	$1,250	$1,250
BEV	$8,000	$8,000	$8,000	$8,000	$8,000	$4,000	$4,000	$2,000	$2,000	$2,000

Public charging infrastructure serves as more than just a substitute for home charging access. For PHEVs it can maximize the use of EV mode vs. internal combustion engine vehicles, and DCFCs provide additional flexibility for BEVs for longer trips or days where they need a top up for any other

number of reasons. Public chargers also support travellers from out of region. Even if home charging access nears 100%, public chargers still have an important role in a charging network.

The modeling assumes considerable retrofits across the whole region, however there are a number of reasons the following retrofits may not be achieved on the schedule included here. For example, these retrofits require cooperation of building owners and tenants, an adequate workforce, and other factors.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Single Family % Home Charging Access	77%	78%	80%	82%	83%	86%	89%	92%	96%	100%
Multifamily % Home Charging Access	25%	29%	35%	41%	46%	54%	63%	73%	83%	94%

Annual Investment

Annual Total Investment, 2021-2025

	2021	2022	2023	2024	2025
Level 2	$0	$0	$746,000	$1,119,000	$1,119,000
DCFC	$0	$0	$2,310,000	$3,465,000	$3,465,000
Total	$0	$0	$3,056,000	$4,584,000	$4,584,000

Annual Total Investment, 2026-2030

	2021	2022	2023	2024	2025
Level 2	$1,119,000	$1,119,000	$746,000	$746,000	$746,000
DCFC	$3,465,000	$3,465,000	$2,310,000	$2,310,000	$2,310,000
Total	$4,584,000	$4,584,000	$3,056,000	$3,056,000	$3,056,000