Electric Vehicles

in Fraser Health, Providence Health Care, Provincial Health Services Authority, and Vancouver Coastal Health

a baseline study and analysis for a regional strategy

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February 24, 2022

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Overview

There has been a large shift in the last year towards electric vehicle (EV) friendly communities, both provincially and regionally. In response to this shift, there is interest from Fraser Health, Providence Health care, Provincial Health Services Authority, and Vancouver Coastal Health, collectively known as the Lower Mainland Health Organizations (LMHOs), to determine the action that health care organizations need to take. Clean BC's provincial targets include 100% zero-emission vehicles (ZEV) by 2035, and the development of ZEV fleet and procurement plans. The 2021-2022 Ministry of Health Board Mandate Letters to the health authorities outline that, as part of a better future through fighting climate change, health authorities must achieve a 40% reduction in emissions by 2030. To meet these targets and to reduce the negative impact that health-care facilities are having on communities, health, and environment, the LMHOs are in need of a collaborative and strategic approach to guide and effectively drive this action.

This study will inform a regional electric vehicle strategy to understand demand, feasibility, and to share resources, learnings, and opportunities with consideration electric vehicle deployment and accommodation within the four LMHOs.

This report is separated into three sections: Background, Staff and Public Charging, and Fleet. Both the Staff and Public Charging, and the Fleet sections include baseline and analysis components.

1. **Background**

This section shows how health care organizations are situated within the broader regional, provincial, and national electric vehicle context.

2. **Staff and Public Charging**

This section provides a baseline of electric vehicle policy, infrastructure, EV management, as well as stakeholders within the LMHOs. The analysis within this section includes an accessibility assessment, electrical feasibility, and stakeholder interviews.

3. **Fleet**

This section provides a baseline of fleet vehicles, fleet management, as well as stakeholders within the LMHOs. The analysis within this section includes a preliminary fleet assessment, as well as stakeholder interviews.

Scope

The baseline study and analysis included the four LMHOs (Fraser Health, Providence Health Care, Provincial Health Services Authority, and Vancouver Coastal Health). This scope of this work did not include the development of an electric vehicle strategy, but aimed to provide the groundwork required for the future development of long-term regional EV and Transportation Demand Management planning.

This study only considered Level 2 and Level 3 (DC Fasting Charging) charging stations, and did not include Level 1. In a workplace setting and for fleet vehicles, it is more effective and efficient to prioritize faster charging options.

The study was also restricted to electric vehicles only, and did not included other form of electric transportation such as e-scooter, pedal-assist bikes, or other forms of electric micro-mobility. This study includes both Battery Electric Vehicles and Plug-in Hybrids. It does not consider the use of conventional hybrid vehicles, or alternative zero-emission vehicles, such as hydrogen vehicles. Transportation by public transit and bicycle were included as a part of the transportation accessibility analysis.

In this initial study, only owned sites were considered within the scope of this study, due to the relatively little influence of and access to leased sites. There may be opportunity to build capacity through future education or relationship building opportunities with building leasers, and future investigation should work more closely with building leasers and property management teams.

Expected Outcomes

- Clarity around the current status of EV chargers and infrastructure across the LMHOs
- Understanding of LMHO stakeholder level of interest in increasing EV accessibility/availability
- Understanding of risk (in not developing a regional strategy)
- Direction for the future of EV charging in the LMHOs
- Engagement with all stakeholders and clarity of roles, responsibilities, and priorities

Disclaimer

The Energy and Environmental Sustainability (EES) Team recognizes that this report has not been developed by a third party or with an objective perspective on these topics. The current status, the gaps, the opportunities within this study, are based on the observations, the engagement, reflections, and analysis of the EES team, who have motivation to drive environmental sustainability and energy conservation initiatives.

The EES team requests that any individuals or departments reading this report help to identify missing components, areas of weakness, and to fill in gaps that may contribute to a greater understanding of the status of electric vehicles, as well as the feasibility of advancing infrastructure and charging for staff, the public, and fleet.

1. Background

This section shows how health care organizations are situated within the broader regional, provincial, and national electric vehicle context.

Policy demand for electric vehicles is increasing

Currently, across the Lower Mainland Health Organizations (LMHOs) there is an opportunity to develop an integrated and collaborative strategy for the future of electric vehicles (EVs). The inevitable increase in demand for EV charging infrastructure, as well as the need to decrease organizational (as well as regional) GHG emissions is an opportunity to position the LMHOs in a leadership role amongst Public Sector Organizations (PSOs) to drive this societal shift, through the provision of accessible EV infrastructure.

On-road transportation produces 35% of total regional[1] and 37% of total provincial emissions[2] mostly comprised of emissions resulting from heavy-duty diesel, and light-duty gasoline. Legislation at multiple levels of government supports the transition to zero-emission vehicles. The Zero-Emissions Vehicle Act[3] (2019) states that by 2040, 100% of auto sales within BC must be a zero-emissions vehicle, while the federal target has been accelerated even further to 2035. CleanBC[4] is the pathway by which the province will accomplish its zero-emissions vehicle targets. Additionally, as a public sector organization, the LMHOs are required to achieve carbon neutrality every year, which includes the payment of carbon offsets for all emissions resulting from mobile sources (fleet).

To support the advancement towards these targets many funding and incentive opportunities are available to commercial entities, to residents, to local governments, and to public sector organizations.

Electric Vehicle Legislation, Plans, and Targets

Federal	
Canadian Net-Zero Emissions Accountability Act	100% of (light duty) vehicles purchased must be ZEV by 2035.
Provincial	
Climate Change Accountability Act	All B.C. public sectors organizations (PSOs) must achieve carbon neutrality every year
B.C. Zero Emissions Vehicle Act	100% (light duty) vehicles purchased must be ZEV, by 2040 (10% by 2025)

[1] Metro Vancouver 2017
[2] Government of B.C. 2021
[3] Zero Emissions Vehicle Act (2019)
[4] CleanBC

	PSOs must have a Clean Fleet Plan and a ZEV-first acquisition policy
Ministry of Health Mandate Letter	Health organization operations must align with targets and strategies for minimizing greenhouse gas emissions and managing climate risk Health organizations must decrease their fleet vehicle emissions by 40% by 2030, and report out on all plans and activities to do so.
Local/Regional	
Metro Vancouver Clean Air Plan Draft (2021) [5]	Passenger vehicles: 65% reduction in GHG emissions from 2010 levels by 2030 Medium and heavy duty vehicles: 35% reduction in GHG emissions from 2010 levels by 2030 All: 25% reduction in diesel particular matter emissions from 2020 levels 40% reduction in NOx emissions from 2020 levels by 2030
Municipal Requirements	See Appendix D
Metro Vancouver Transportation Strategy Draft (2021)[6]	By 2030 we have lowered greenhouse gas emissions from light-duty vehicles by 65% over 2010 levels; and have eliminated transportation greenhouse gas emissions altogether by 2050.

Electric vehicle ownership is increasing

The Lower Mainland and British Columbia have experienced exponential growth in the EV sales (Table 1, Figure 1, Gowling WLH 2021), supported by B.C.'s strategy to increase EV sales, the availability of provincial and federal incentives, and growth in EV market share. Zero-emissions vehicles account for nearly 8.4% of all new vehicles sales in B.C.[7]. Amongst staff within Fraser Health, Vancouver Coastal Health and PHSA, EV ownership has doubled since 2019, an increase that is expected to continue in the next five years and beyond (Table 2). Despite the apparent decrease in ownership in Providence, low survey participation rate (in 2019) is a potential reason why we do not see the same ownership trend as in the other LMHOs.

[5] Metro Vancouver Clean Air Plan- Draft (2021). http://www.metrovancouver.org/services/air-quality/engagement/clean-air-plan/Pages/default.aspx
[6] Metro Vancouver Regional Transportation Strategy – Draft (2021). https://www.transport2050.ca/
[7] Electric Autonomy 2021

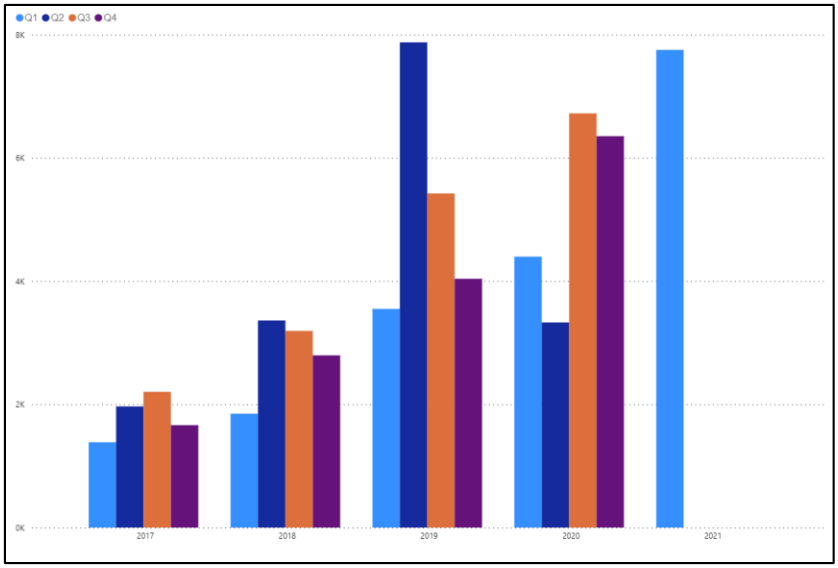


Figure 1 Registration of new Battery and Plug-in Hybrid Electric Vehicles in British Columbia (Source: Stats Can 2021)

Table 1 Electric Vehicle Ownership and Growth in the Lower Mainland Health Organizations (Source: GreenCare Survey)

Health Organization	2019 EV ownership	2021 EV ownership	Staff who plan to own an EV (in next five years)	Staff who are unsure if they will own an EV in the next five years
Fraser Health	5%	10%	37%	38%
Providence Health Care	7%*	6%	32%	31%
PHSA	5%	10%	38%	29%
VCH	4%	8%	39%	29%

*The margin of error for Providence Health Care in the 2019 GreenCare Survey was 8%. With such a high margin of error, it is difficult to know what the actual percentage of EV ownership might be.

The electric vehicle market is growing

Vehicle manufacturers continues to release new electric vehicles, with continued growth and expansion of EV capacity and functionality. As EVs take up a larger percentage of the market, prices will decrease, and ownership will increase as the financial barrier is reduced.

Many car manufactures have committed to producing various percentages of electric vehicles, including a goal of 100% by Jaguar (2025), Audi (2033), Volkswagen (2025+), and Jaguar Land Rover (2036).

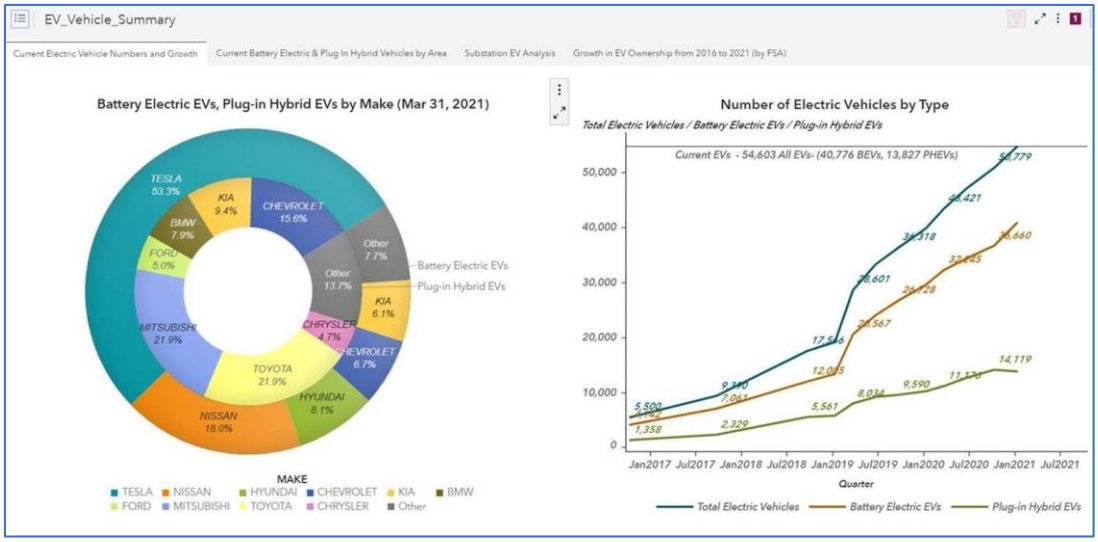


Figure 2: Growth of Electric Vehicle Market Share (BC Hydro)

Electric vehicles are one piece of the transportation puzzle

While it is important to encourage electric vehicles use and adoption by staff, the role that these charging stations are playing needs to be considered, and ultimately the larger transportation system as a whole needs to be considered.

Electric vehicles are single occupancy vehicles, a method of transportation that the LMHOs are actively trying to reduce within the health authorities (and regionally). Increasing commuting by public transit, by cycling, and by other modes of 'micro-mobility' (e-bikes, e-scooters, etc.) and active transportation are more advantageous with consideration to individual health, community health, the health of the environment, and reduction of strain on municipal and health care traffic and parking operations.

Despite regional goals to reduce single occupancy vehicle use, depending on the location of some facilities they will likely always be an important transportation. A piece of the puzzle will be ensuring that those vehicles that do come to health-care facilities are electric or low carbon.

Additionally, electric vehicles continue to require materials and resource for their extraction, operations, as well as produce waste and emissions once they are no longer operational. Electric vehicles within their life cycle have negative environmental consequence that, while are comparatively less compared to internal combustion engines, should still be addressed (See Appendix L: Environmental Consequences of Electric Vehicles)

Health care organizations play a role

The EV Charging Pyramid (Figure 1) is a standard prioritization method used by local government for the development of charging station networks. While charging at home remains the primary mode by which EV owners should be charging their vehicles, work place charging still plays an important role, especially for those employees who do not have access to charging at home.

Health care organizations, as large employers, with diverse workforces, will play a key role in providing charging, when required, for employees.

Additionally, health care organizations have a responsibility to take action towards a behaviour that directly affects the health and wellbeing of people, and the environment (Appendix H: Electric Vehicles and Public and Community Health)

Figure 3 EV Charging Infrastructure Prioritization (Source: Argonne National Laboratory)

2. Staff and Public Charging

This section shows the baseline and analysis of staff and public charging at LMHO facilities.

Baseline

Stakeholders

Energy and Environmental Sustainability Team

The Energy & Environmental Sustainability Team (EES) is a Collaboration Program of the Lower Mainland health organizations – Fraser Health Authority, Providence Health Care, Provincial Health Services Authority and Vancouver Coastal Health Authority.

The purpose of EES is to inspire and empower all we work with to collaboratively enable systemic transformation so that we can restore and regenerate the interdependent health of people, place and planet – now and for future generations.

EES has an interest in engaging stakeholders throughout the LMHOs, to address the need to shift towards vehicle electrification (amongst staff, public, fleet), and to facilitate this change, and alignment to achieving health authority, provincial, and national targets. EES has facilitated and lead several EV charging station initiatives throughout the LMHOs, and has been a key driver of this work.

Facilities, Maintenance and Operations

The Facilities, Maintenance and Operations (FMO) teams within each of the LMHOs are key stakeholders, with regard to both staff and public, as well as fleet vehicle charging. Along with managing site operations, FMO is also responsible for parking management at the LMHO owned site in which Integrated Protection Services (IPS) does not manage parking. Additionally, FMO has a large number of LMHO fleet vehicles, and are key stakeholders with consideration to fleet electrification.

Integrated Protection Services

Integrated Protection Services (IPS) is a consolidation of security/protection, parking and Transportation Demand management, Photo Identification, and Access Control programs that works across the Fraser Health, Provincial Health Services Authority, and Providence Health Care. Within IPS's scope is the installation, management, and maintenance of EV charging stations within IPS managed parking lots. IPS also provides parking services and enforcement within Vancouver Coastal Health.

Vancouver Coastal Health, Healthy Transportation

VCH Healthy Transportation current manages much of VCH's Transportation portfolio, including the VCH transit program, bike cage access (as of September 2021), and the VGH commuter centre. This role/department has not historically been responsible for EV installation, management or maintenance.

Stakeholder Engagement and Interviews

Table 2 Stakeholders engaged through interviews, or calls, and whose input was incorporated into baselining, analysis, and identification of gaps and opportunities for staff and public EV charging

	Department	Individual, Position
Internal		
Fraser Health	Energy and Environmental Sustainability Team	Jeson Mak, Fraser Health Energy Manager Cathy McDonald, Energy Coordinator
	Facilities, Maintenance and Operations	Martin Wright, Director
Provincial Health Services Authority	Energy and Environmental Sustainability Team	Ghazal Ebrahimi, PHSA Energy Manager, Douglas Davila, PHSA Energy Specialist
	BC Emergency Health Services	José Font, Sr. Business Analyst, Logistics and Transportation Operations Alain Mangano Robert Howland, Fleet Operations, Director
	FMO, BC Cancer and Research Center	Tom Stodola, Research Building Operations Shubhkarm Sidhu, FMO Manager Bill Young, FMO Supervisor
	BC Mental Health and Substance Use Services	Drew Hart, Director, Facilities Management & Capital Projects Jessica Lam, Project Manager
Providence Health Care	Energy and Environmental Sustainability Team	Mehrdad Gharibnavaz , Providence Energy Manager
	FMO	Tony Munster, Executive Director of Projects and Planning (no interview, but provided input) Don Wills, Director Logistics and Facilities Services (No interview, provided input)
Vancouver Coastal Health	Planning and Projects	Ashok Mishra, Director
	Healthy Transportation	Healthy Transportation Lead
	Energy and Environmental Sustainability Team	Kori Jones, VCH Energy Manager
All	Integrated Protection Services	Navdeep Nijjar, TDM and Commuter Services Coordinator
Additional Engagement		
	Sunnybrook Health Science Centre	Saleh Diae, Manager of Energy and Sustainability
	University Hospital Network	Lisa Vanlint, Energy Stewards
	Vancouver Island Health Authority	Rod Yarrow, Parking Manager Nicholas Dunning, Fleet Manager
	Electrum Charging Solutions	Neil MacEachern, Chief Sustainability Officer
	Plug In BC (Fraser Basin Council)	Patrick Breuer, EV Advisor

	District of Squamish	Ian Picketts, Manager of Sustainability and Climate Change
	SWTCH Energy	Carter Li, CEO & Co-founder Chris Ceraldi, Business Development Manager
	Prism Engineering	Adam Franklin, Electrical Engineer
	District of North Vancouver	Brendon James, TDM Coordinator Adam Wright, Sustainability Planner

Policy Scan

Different levels of government are able to utilize different tools, or levers, to steer the transition to low carbon transportation. The Provincial (BC) and Federal governments have set targets for the percentage of new vehicles sales that must be electric. Municipalities are able to dictate charging infrastructure requirements, through zoning bylaws, and may use other methods, such as pollutions charges and parking fees. Currently, the LMHOs do not have any policy directing the installation of EV charging infrastructure, or outlining how health-care facilities should support or manage the increase in electric vehicles.

Local Requirements

Municipal EV planning is based on a model for which home charging provides the majority of charging access, followed by workplace and then public charging (Figure 1).

One of the greatest barriers to EV adoption has been the accessibility to charging infrastructure within Multi-Unit Residential Buildings (MURBs) (Source: Interview with District of North Vancouver). Due to the high level of MURB development throughout the Lower Mainland, the need to include EV charging requirements was identified as one of the greatest ways to encourage EV adoption.

Because of this, many municipalities and regions have municipal requirements that outline EV requirements within new developments (Appendix D: Municipal and Regional Electric Vehicle Requirements and Strategies). Zoning bylaws are the primarily means by which municipalities are able to enforce these requirements.

The scope of municipal zoning bylaws, the primary mechanism by which EV infrastructure requirements are enforced in new development, is primarily *Residential*, and occasionally *Commercial* zoning. As health-care facilities are zoned as *Institutional*, or *Mixed-use*, these requirements do not have an impact

Leadership in Energy and Environmental Design (LEED)

As outlined in the Health Capital Policy Manual Policy #11, all provincial health authority capital projects and major redevelopments are required to achieve LEED Gold certification (or equivalent).

Project teams have the option of achieving (1) credit within the Location and Transportation category:

LEED v4: Green Vehicles[8]

[8] LEED v4 Credit Library: Green Vehicles

- Designate 5% of all parking spaces used by the project as preferred parking for green vehicles.
- Install electrical vehicle supply equipment (EVSE) in 2% of all parking spaces used by the project. Clearly identify and reserve these spaces for the sole use by plug-in electric vehicles.

LEED v4.1: Electric Vehicles[9]

- Install electrical vehicle supply equipment (EVSE) in 5% of all parking spaces used by the project or at least two spaces, whichever is greater; OR
- Make 10% of all parking spaces or at least 6 spaces EV Ready, whichever is greater. To be EV Ready, include a dedicated electrical circuit with sufficient capacity for each required space.

While the Green Vehicles/Electric Vehicles credit is listed as mandatory within the *EES Design Guidelines for New Construction and Major Renovations*, these guidelines are not strictly enforced, and there is no repercussion for non-compliance. Additionally, the number of parking stalls required to be electrified, in order to earn the LEED credit, will not be great enough to meet rising demand of EV charging stations.

Existing Charging Stations

The charging stations considered within the scope of this study, are those that are owned or operated by an LMHO department (most often IPS or FMO). Charging stations located on leased sites are out of scope for this study.

While Level 1 charging stations (120V wall outlets) are not included in the scope of the study, they are included in the charging station summary, to provide a more complete picture of the types of charging options that are available at some sites.

Table 3 Charging Stations within the Lower Mainland Health Organizations. Usable facility area data provided by the Real Estate department within each LMHO. 2020 FTE data provided by Health Employers Association of BC. Charging Station data provided by Integrated Protection Services.

Health Organization	Site	Usable facility area (m^2)	2020 FTE	EV Charging Stations	
				Level 1	Level 2
Fraser Health	Abbotsford Hospital and Cancer Centre	62,258	1475	10	3
	Burnaby Hospital	48,089	1156	0	10
	Chilliwack General	2,976	718	0	2
	Fraser Canyon Hospital	7,677	100	0	2
	Jim Pattison Outpatient Care	19,941	493	19	0
	Langley Memorial Hospital	37,751	968	0	2
	Mission Memorial Hospital	22,064	308	3	0
	Royal Columbian Hospital	64,747	2415	0	7
	Ridge Meadows Hospital	23,238	763	0	4
	Surrey Memorial Hospital	115,112	3664	0	14

[9] LEED v4.1 Credit Library: Electric Vehicles

			Total Fraser Health	32 Level 1	44 Level 2
Providence	St. Paul's Hospital	111,921	3254	6	8
			Total Providence	6	8
PHSA	BC Cancer and Research Centre	21,375		9	0
	BC Children's Hospital and BC Women's Hospital + Health Centre	209,796	3301	4	1
			Total PHSA	13 Level 1	1 Level 2
VCH	Vancouver General Hospital	247,591	6210	0	4
	Richmond Hospital	34,076	950	0	30
	Lions Gate Hospital	68,223	1513	4	3
			Total VCH	4 Level 1	37 Level 2

Leased Sites

The health authorities have historically had challenges in making any major infrastructural change or improvements to leased buildings or sites. However, there is immense value and opportunity in working with leased sites and including these locations within future strategy and analysis.

Currently, there are several potential solutions and opportunities at leased sites, such as the shifting the capital costs of EV charging infrastructure to an operationalized cost, which results in infrastructure costs being paid off over time (from the leaser), and the owner/leaser gaining an asset over time. EV service providers may be able to facilitate and negotiate the development of agreements with building managers or leasers.

Some leased sites currently have EV charging stations, though aside for staff reporting it is a challenge to keep a record of the sites, as well as the number of charging stations and charging station management. Charging stations within Leased sites are managed by the building owner, independent of the LMHOs.

Charging Station Management

Charging stations are, generally, managed by the entity that manages parking. This holds true for all sites, except for those in VCH. As of June 2021, VCH FMO has taken over the ownership and maintenance of the charging stations within VCH parking lots, which may include the support of EES or IPS, when required.

Fraser Health	IPS-managed parking lots	IPS
	Fraser Canyon Hospital	FMO
Providence Health Care	IPS-managed parking lots	IPS
	St. Vincent's Langara	FMO
	IPS-managed parking lots	IPS

Provincial Health Services Authority		
	BC Cancer and Research Centre	FMO
Vancouver Coastal Health	VGH	FMO
	Richmond Hospital	FMO

Parking Management and COVID-19

From April 2020 until March 2022, the B.C. Ministry of Health suspended all pay parking at B.C. health authority owned and operated sites. Parking fees are one of the mechanisms to deter staff from driving. Due to the suspension of fees, many staff have chosen to commute to work via a personal vehicle, which has been observed due to the immense increase in demand for parking, as well as anecdotally. There was hesitancy enforce EV charging fees until parking fees were reinstated. User and charging fees are the most effective mechanism to manage EV charging stations and the ensure turnover. There has been no previous enforcement of EV charging fees in any of the LMHOs.

Current Electric Vehicle Initiatives and Projects

There are currently several electric vehicles initiatives and projects within the LMHOs (Table 5). Each project has a unique scope, stakeholders, and project lead. This table highlights opportunities to share learnings between the different projects, and the importance of communication between the different projects and stakeholders, to ensure that all individual installations will be a cohesive component of a greater EV charging network across the LMHOs.

Table 4 Current electric vehicle charging station projects and status throughout the LMHOs

Health Organization	Site	Details	Status	Lead
Fraser Health	Burnaby Hospital Chilliwack General Fraser Canyon Hospital Eagle Ridge Hospital Langley Memorial Hospital Mission Memorial Ridge Meadows Royal Columbian Hospital Surrey Memorial	EV Expansion Project Preliminary site assessments and quotes contingent on electrical studies	Waiting for funding availability	IPS
	Surrey Memorial Eagle Ridge Hospital Mission Memorial Hospital Delta Hospital Peace Arch Hospital Ridge Meadows Hospital Chilliwack General Hospital	Site contacts engaged for electrical feasibility assessment (staff and fleet).	Pursuing feasibility study	EES
Providence	St. Paul's Hospital Mt. St. Joseph St. Vincent's-Langara Holy Family Hospital	Charging station installation and expansion project (staff and public, and fleet)	Feasibility studies complete	EES

PHSA	BC Cancer Research Centre	Charging station expansion project for staff charging	Feasibility studies complete	EES
	Forensics Psychiatric Hospital	Staff and public, and fleet charging installation	Pursing feasibility study	EES
	BC Children's Hospital and BC Women's Hospital + Health Centre	Staff and public installation	Waiting for funding availability	IPS
VCH	Sechelt Hospital Powell River General Hospital Richmond Hospital GF Strong Squamish General Hospital Whistler Health Care Centre Lions Gate Hospital Vancouver General Hospital	VCH EV Expansion Project. Includes 16 Level 2 charging stations and 8 Level 3 charging stations (fast chargers)	Conditional approval received (Winter 2022). Moving ahead with performance specs development.	EES/ Richmond Redevelopment

Electric Vehicle Metrics

Several types of metrics are valuable for the management of EV charging stations. These metrics may include: Number of vehicle-users, charging time per vehicle, electricity consumption, time of charging station vacancy, usage by time (of day).

Currently, there are minimal data or metrics measurable or measured within the Lower Mainland Health Organizations. The Richmond Hospital installation is the first installation in which there will be long term, accessible data available, due to their working with an external end-to-end service provider. The installation opened in April 2021, and will soon have access to reporting from the Thirty charging stations.

While data is technically available through other EV vendors (such as Flo and Charge Point), there is currently no data exchange with these companies, and past attempts to issue service and maintenance requests for the upkeep of the charging stations has been challenging.

Burnaby Hospital recently ran a pilot to understand capacity to manage the energy load of ten Level 2 charging stations, and the impact that EV charging has on building energy demand. The study found that the use of 'smart controllers' (devices that control the amount of power to each charging station) were able to reduce combined power demand during peak times when electricity is in higher demand and more costly.

Analysis

Stakeholder Engagement

Amongst all of the stakeholders, there is overall support for an increase in electric vehicle infrastructure at health care facilities.

Stakeholders, in general were supportive and acknowledged that electric vehicles are the 'way of the future', and that there is need for the health organizations to increase work in this area; this support was partnered with strong concerns around the responsibility, implementation, and risk of making any changes.

Four main themes emerged from the fourteen interviews, as well as the nine additional informal conversations (not structured as interview) with stakeholders.

Note: The original stakeholder language was preserved in the below bullet points.

Roles and Responsibilities	• Needs to be a clear Health Authority Standard (OPR – Owner Project Requirement – as an owner this is what we expect) • There is currently a grey zone with maintenance – need to contact parking services if a charger is broken. FMO gets the call the help fix it, but then FMO is concerned that if they then break (in the maintenance process) then they are liable for the repair • Need to understand who is responsible for the repairs • Need a Memorandum of Understanding ('MOU')
Financial Impact	• Providing 'free charging' to staff and public • Increasing electrical costs, without cost-recovery • Who is paying for utilities, what are the maintenance costs? What is the revenue opportunity, infrastructure costs, background costs • FMO doesn't want to be paying for the electricity • Concerns with providing free charging to staff and public (Note: IPS are planning to implement a pay structure) • Interest in exploring revenue sharing opportunities, to make the programs cost neutral, or to actual make net gain
Parking Impact	• How to enforce turnover and expect health-care staff (specifically those in acute care) to move their vehicles • Due to overcapacity of parking lots, where will vehicles park once leave a charging station stall • How to manage "ICEing" (parking by non-EV vehicles)
Building Impact	• Concerns around cost associated with peak demand (higher electrical costs when electrical demand on the grid is higher) • FMO would like real time control of the charging stations, to manage electrical load. • Concern about demand of Level 3 chargers (too high electrical demand for the building)

Transportation Accessibility

Using access to guide electric vehicle charging installation

While there is motivation to support, encourage, and drive the transition from gas and diesel single-occupancy vehicles to electric or other zero-emissions vehicles, alternative forms of transportation, such as cycling and public transit need to be considered and prioritized.

In general, the installation of EV charging stations has been directed by current and future demand, as well as ease of implementation. By understanding transportation accessibility, we can identify access gaps that can guide the implementation of charging stations (based on non-access by alternative means to single occupancy vehicle).

For the purpose of this study, accessibility was used as the first indicator by which to identify potential sites for EV charging installations. Other factors, such as usable facility space, site FTE, as well as engagement with site facilities, maintenance and operations stakeholder should also be considered. Beginning the site identification with access is a way to ensure that equal access to charging is being addressed as a priority.

Please see Appendix E: Transportation Accessibility Assessment for a detailed breakdown of the assessment, and the scoring of each category.

Assessment Outcome

Based on their low transportation accessibility score, the below facilities were identified as sites that, from an accessibility and holistic approach to transportation access, would more greatly benefit from the installation or expansion of EV charging stations.

Fraser Health	• Chilliwack General Hospital • Delta Hospital • Eagle Ridge Hospital • Mission Memorial Hospital • Peace Arch Hospital • Ridge Meadows Hospital • Royal Columbian Hospital • Surrey Memorial Hospital
Providence Health Care	• Holy Family Hospital • Mount St. Joseph Hospital • St. Vincent's Langara
Provincial Health Services Authority	• Forensics Psychiatric Hospital
Vancouver Coastal Health	• Berkley Care Centre • Cedarview Lodge • Powell River (complete) • Sechelt Hospital (complete) • Shorncliffe Intermediate Care • Sumac Place • Whistler Health Care Centre

Electrical Feasibility

Once a site has been identified as a potential site for EV installation or expansion, based on transportation access, FTE, facility size, and site-level engagement, an electrical feasibility study needs to be done to understand the site's capacity for an installation.

Ideally, the electrical feasibility study will be completed by an electrical engineering consultant that is familiar with the facility, and aware of past, current, and any future planned projects that will impact electrical capacity at that site.

This study is absolutely essential to ensure that the a building is able to accommodate EV charging, and to mitigate any risk associated with electrical capacity reduction at a certain site. It is also necessary to determine if electrical upgrades will be needed to accommodate some EV charging, and to ensure that EV charging is considered within any upgrade planning.

It is also important to note, that electricity does not need to be supplied from the building in all cases. There are also opportunities, depending on the location and installation size, to work with BC Hydro and pull electricity directly from the grid.

Scope of work for this initial study can include:

- Conduct load analysis to estimate available capacity of existing electrical distribution system (From BC Hydro data, and data for temporary power meters). Please provide a separate line item in your fee table summary for load analysis (with temporary meters)
- Provide charging options assessment (where charger can be located, how many can be installed, load sharing availability, etc.)
- Provide cost estimates for deployment options
- Provide marked-up electrical drawings
- Provide support for completion of rebate documentation (list of applicable rebates, as well as support to apply for, if applicable)

To align with *Carbon Neutral Capital Project* application metrics, additional information can be requested within the report:

- Total project cost (including infrastructure upgrades)
- Annual fuel savings (GJ & $)
- Annual electricity increase (kWh & $)
- Total annual avoided emissions (tCO2e/year)
- Persistence (life of assets)

Gaps and Opportunities

Through the stakeholder interviews and review of best practices, several gaps were identified in how staff and public electric vehicle charging is currently being managed and operated. The intention of identifying these gaps is to address the barriers that currently exist to having a more strategic and efficient, regional approach to charging.

The opportunities identified are presented as options, not as prescriptive recommendations. These potential solutions should be explored, collectively, to determine which are the most feasible and effective ways to bridge the identified gaps.

Gaps	Opportunities
Leadership and Policy	
Absence of internal policy or formalized guidance/instruction from leadership *The absence of clear instruction or guidance on how charging should be addressed, and supported within the health organizations has resulted in an ad-hoc approach by various groups, with unclear roles and responsibilities.*	Pursue executive sponsorship to support the development of an EV strategy and policy.
Communication	
Gaps in communication (and awareness) between ongoing EV projects and work within the health organizations, resulting in inconsistencies and potential lost learnings and efficiencies *Different groups may be installing EV charging stations, but there is not necessarily communication or communication between them.*	Formalize a steering group of EV stakeholders to ensure EV work is coordinated, to facilitate communication, and to increase efficiency and build capacity. Continue to engage with stakeholders to address the identified gaps, explore opportunities to maintain ongoing communication between stakeholders.
Formalization and Management	
Unclear how to collaborate on this work and what should be the delineation of roles and responsibilities between and within each health organization	Jointly develop an EV strategy and policy (with all key stakeholders) from each health organization.

Different groups that make up the EV landscape may otherwise be unconnected within the formal structure of the health organization. It is unclear how these groups should be working together, and how the roles should be fulfilled.	Consider the development of separate, parallel 'pathways' for each health organization within a wider regional electric vehicle strategy.
No building standards (municipal bylaws, LEED credit requirements) to ensure health organizations are EV-ready *Municipal EV bylaws do not include health care, project teams may opt not to proceed with LEED EV credit, and it is not necessarily sufficient to meet growing demand.* No standardized use of EV charging best-practices for capital projects, across all sites *Depending on which groups are engaged, at which project phase, different input may be provided to address EV charging for capital projects. The input provided by different groups is currently not standardized or transparent.*	Leverage other opportunities to influence capital projects and develop policy for the inclusion of EV charging in new construction. Ensure that EV-readiness and EV best practices are embedded into capital project planning and design.
Absence of data, gaps in data, no data streamlining for reporting and collection *The absence of data and metrics means that deeper analysis is not possible (I.e. How many staff/vehicles charge, how much does the electricity cost, how many hours a vehicle stays at a station, etc.).*	Establish metrics and a standardized reporting framework for charging station implementation, management, use and experience.
No standard practice for EV feasibility studies and installation *The process is which different consultants (I.e. Electrical engineers, EV Service Providers) may vary, depending on who is leading the project.*	Establish standardized procedure for feasibility studies, infrastructure assessment, leveraging experience with existing infrastructure.
Varied (inconsistent) support from EES *Depending on resources, leadership support, and engagement with on-site staff, some sites or health authorities may receive greater EV support*	Recognize that unique processes and opportunities may result in different outcomes for each health organization.

No standardization of EV parking and management and operations *There is no collectively agreed-upon approach to how parking will be managed for EVs, across all sites and health organizations (I.e. IPS only manages IPS-managed parking lots, no management at VCH sites)* *There are still many gaps in recommendations for how EV parking should be managed, especially in a health care context, when parking demand is very high and staff may have long, demanding shifts.*	Establish roles and responsibilities around EV charging stations management and ownership. Co-develop standardized external communications plan, management, and etiquette guidelines. Explore revenue (or cost-recovery) sharing opportunities.
Additional Gaps	
No engagement with Population and Public Health	Include Population and Public Health within the development of an EV strategy.
Increased electric vehicle usage does not mitigate many impacts associated with personal vehicle usage	Focus on additional Transportation Demand Management measures to reduce parking demand at sites with high access to transit, active transportation, and share modes.
No integration of EV installation and upgrades into existing processes	Incorporate EV feasibility and assessments into all future electrical upgrades. Provide more EV education within Facilities Management to increase identification of EV opportunities, within a project or process.

3. Fleet

This sections shows the baseline and analysis of fleet and fleet electrification within the LMHOs.

Baseline

Fleet Overview

Each health organization fleet is managed independently. The fleets include all vehicles that are leased, or owned, and operated by each LMHO. Fleets do not include staff personal vehicles used for work purposes, or the hospital shuttles.

Currently there are no electric vehicles in any of the LMHO fleet.

Stakeholders

Table 5 Stakeholders that were engaged through interviews, or calls, and whose input was incorporated into baselining, analysis, and identification of gaps and opportunities for fleet electric vehicles and charging

	Department	Individual, Position
Internal		
Fraser Health	Energy and Environmental Sustainability Team	Jeson Mak, Fraser Health Energy Manager Cathy McDonald, Energy Coordinator
	Supply Chain	Ted Gagnon, Buyer (Fleet Vehicle Procurement) Brian Klassen, Senior Buyer (Fleet Vehicle Procurement)
	Facilities, Maintenance and Operations	Martin Wright, Director
Provincial Health Services Authority	Supply Chain	Michael Neville, In-hospital replenishment Lead (Fleet Coordination and Procurement)
	Energy and Environmental Sustainability Team	Ghazal Ebrahimi, PHSA Energy Manager, Douglas Davila, PHSA Energy Specialist
	BC Emergency Health Services	José Font, Sr. Business Analyst, Logistics and Transportation Operations Alain Mangano Robert Howland, Fleet Operations, Director
	BC Mental Health and Substance Use Services	Drew Hart, Director, Facilities Management & Capital Projects Jessica Lam, Project Manager
Providence Health Care	Energy and Environmental Sustainability Team	Mehrdad Gharibnavaz , Providence Energy Manager
	FMO	Tony Munster, Executive Director of Projects and Planning (no interview, but provided input)

		Don Wills, Director Logistics and Facilities Services (No interview, provided input)
VCH	Energy and Environmental Sustainability Team	Kori Jones, VCH Energy Manager
Additional Engagement		
	Vancouver Island Health Authority	Rod Yarrow, Parking Manager Nicholas Dunning, Fleet Manager
	Electrum Charging Solutions	Neil MacEachern, Chief Sustainability Officer
	Automotive Resources International	David Holdsworth, Account Executive, Client Relations
	Plug In BC (Fraser Basin Council)	Patrick Breuer, EV Advisor
	SWTCH Energy	Carter Li, CEO & Co-founder Chris Ceraldi, Business Development Manager
	Prism Engineering	Adam Franklin, Electrical Engineer
	District of North Vancouver	Brendon James, TDM Coordinator Adam Wright, Sustainability Planner

Policy Scan

Under the CleanBC 2050 target, public sector organization (PSO) fleets will need to be aligned with this target and work towards the purchase of 100% ZEV by 2035. In order to do this, we need to have a clear, consistent, standardized, and proactive approach to ensure that the charging infrastructure is in place, or planned for when these vehicles are purchased, or for when the market options become available.

As apart of CleanBC, PSOs will need to develop Clean Fleet Plans and Zero-emissions vehicle (ZEV) acquisition policies. These policies, at the time of this report, will not be mandated.

Clean Fleet Plan

A multi-year clean fleet plans including fleet composition, vehicle acquisitions and infrastructure requirements. The Clean Fleet Plan will apply to Fraser Health, PHSA, and VCH, as each have over 20 fleet vehicles in their fleet. A clean fleet plan will require more standardized coordination and communication between the fleet departments, as well as between FMO, EES, and any other stakeholder facilitating the transition to electric vehicles, along with any additional installation of infrastructure, support and access to funding or subsidy programs, etc.

ZEV First Acquisition Policy

All PSOs must follow a prioritized sequence when acquiring a light-duty vehicle, beginning with ZEVs If a ZEV is not feasible and the purchase cannot be delayed, hybrid (non-plug in) and then internal combustion vehicles can be considered

West Coast Electric Fleet Pledge

The West Coast Electric Fleet Pledge aligns the efforts of public and private fleets to take action and expand the use of zero-emissions vehicles. Signing the pledge is a pre-requisite of some funding opportunities, such as those offered through Plug-in BC, through their Go Electric Fleets program.

Fleet and Emissions Summary

As Public Sector Organizations, each LMHO reports its carbon footprint based on guidelines provided by the Carbon Neutral Government Regulation and Climate Action Secretariat in British Columbia.

The Climate Action Secretariat uses various elements of reporting, based on the Greenhouse Gas Protocol Corporate Standard, which has classified carbon reporting into three scopes. Of these three scopes and various elements within each scope, the Climate Action Secretariat has determined the LMHO's carbon footprints comprise six different greenhouse gases that are converted to tonnes of carbon dioxide equivalent (tCO2e). The main sources of emissions are categorized into three main groups:

- Stationary Fuel Combustion and Electricity (Buildings)
- Mobile Fleet Combustion (Fleet and other equipment)
- Supplies (Paper)

Each LMHO is required to purchase carbon offsets from the Ministry of Environment and Climate Change Strategy, at $25 per tCO2e.

The current method for fleet emissions reporting has its limitations, as it does not include emissions from personal vehicle use or hail or rideshare services (taxi, Uber, carshare) for fulfilling job duties. The inter-hospital shuttle services are also not included within the scope of the annual reporting, nor is the aviation fleet (for BCEHS).

Save for BCEHS, emissions from fleet make up a small percentage of total emissions from the LMHOs (Table 8).

Table 6 LMHO Fleet Vehicle Summary

Health Organization	Fleet Vehicles 2020					Emissions[10]			
						2019		2020	
	Car	Bus	Heavy Commercial	Light Commercial	Total	Emissions (tCO_2e)	% of Total Emissions	Emissions (tCO_2e)	% of total organization emissions
BCEHS*	185	0	91	622	898	13864	-	13013	89%
PHSA	53	3	11	15	82	175.4	0.93%	203	1.09%
Fraser Health	5	11	1	5	22	109 tCO_2e	0.3%	49.7	0.19%
Providence	0	3	0	2	5	49.7	0.45%	22.2	0.22%
VCH	13	9	3	14	39	79.3	0.2%	80.2	0.2%

*BCEHS is a part of PHSA, but currently reports out on their emissions separately, and manages their fleet independently.

[10] Emissions from mobile sources (i.e. fleet vehicles) are one of the three emissions sources that the LMHOs are provincially mandated to report on.

Fleet Management Summary

Each health organization manages their fleet independently and uniquely. PHSA Supply Chain facilitates the procurement of the fleet vehicles for each.

Fraser Health	PHSA Supply Chain (Ted Gagnon) facilitates fleet vehicle coordination and procurement. Fraser Health has been shifting to a staff vehicles model, in which staff use their personal vehicles and submit mileage, as opposed to using health authority vehicles.
Providence Health Care	Providence does not have a dedicated fleet coordinator, though all fleet vehicles are within the same department (FMO) and the fleet is quite small (five vehicles). Providence Finance does not keep a record of fleet vehicles or department information.
Provincial Health Services Authority	PHSA Supply Chain (Michael Neville) coordinates PHSA Fleet. PHSA has recently been shifting towards a leased fleet model, instead of owned.
Vancouver Coastal Health	VCH does not have dedicated fleet coordination. VCH Finance keeps a record of all fleet vehicles, and department information
BC Emergency Health Services	BCEHS has a team dedicated to the management and coordination of its fleet and procurement.

BC Emergency Health Services

BC Emergency Health Services (BCEHS), while a part of PHSA, operates its fleet independently of the other health organizations.

Currently, the British Columbia Emergency Health Services (BCEHS) fleet has approximately 800 vehicles, of which approximately 75% are ambulance-type vehicles. While mileage has decreased in the last few years (Source: BCEHS interview), the fleet consumes 6.5 million liters fuel per year, and the fleet has a much greater impact with regards to carbon emissions (compared to the other health authorities where fleet is minimal, relative to emissions resulting from stationary sources).

BCEHS has trialed the use of 24 hybrid (not plug-in) ambulances, purchased as an aftermarket hybrid electric system that is installed in ambulances. This trial found that there were no significant financial or environmental benefits to the use of these systems (through reduced fuel consumption.

Currently, the market availability for all-electric, purpose-built ambulances is extremely limited. However, with the recent release of the North American Demers eFX Ambulance, market can be expected to shift. Aside from the overall environmental, and eventual financial benefits to an electric fleet, BCEHS has identified other staff health and wellness, as well as performance benefits, including elimination of exhaust concerns in ambulance bays, elimination of heat concerns within vehicles (vehicles get hot from engine, can't keep A/C when immobile).

One of the challenges that exist for BC EHS, is that, as a provincial service, vehicles can be dispatched anywhere within the province, regardless of EV infrastructure connectivity that would be needed, especially with the time-sensitivity of the majority of the fleet (on-demand service, 24 hours/day).

Analysis

The purpose of this analysis was to understand how current policies apply to LMHO fleet, to identify potential electric vehicles candidates, as well as to understand current gaps that need to be addressed to ensure a smooth transition to fleet electrification.

Several considerations need to be made to the feasibility of transitioning to an electric fleet. Due the inconsistencies between the management of each LMHO, the actions taken to facilitate the transition may be unique to each. Considerations made, to assess the preliminary feasibility include the identification the fleet vehicles that would be good EV candidates, engagement with the fleet vehicle end-user, as well as presence of other potential electric fleet vehicles that park in the same location.

Policy

The 2021-2022 Ministry of Health Board Mandate letter to VCH outlines that by 2030, the health authority fleet must reduce greenhouse gas emissions from fleet by 40% (based on 2010 emissions). The authority must also document and report on all activities dedicated to accomplishing this goal.

Additionally, a provincial target has been set for all PSO fleet to have 100% of light duty fleet vehicles be ZEV by 2027.

As outlined in CleanBC, all PSO fleet must comply with two policies, that include the development of a Clean Fleet Plan, as well as the implementation of a ZEV First Acquisition Policy. These two policies have the potential of becoming regulations (with repercussion for non-compliance), though there is currently no targeted date for development.

Stakeholder Engagement

Similarly to staff and public charging, amongst all of the stakeholders, there was almost unanimous support for a transition to electric fleet vehicles within the LMHOs.

Five main themes emerged from the fourteen interviews, as well as the nine additional informal conversations (not structured as interview) with stakeholders.

Note: The original stakeholder language was preserved in the below bullet points.

Cost	• Cost is the primary concern • Upfront cost (EVs more expensive) • Installation and maintenance of charging stations
Policy	• Purchasing is [currently] reactive. Health authority needs clear vision of what they are trying to achieve • Culture isn't there is submit bids for EVs • Needs support from the CFO, needs to come from the top
Roles and Responsibilities	• No standard protocol for fleet vehicle management in any health authority
Vehicle Reliability and Range	• Need to change culture and fear around range anxiety
Logistics	• No dedicated parking stalls for fleet vehicles • Health authorities decided no to dashcam and telematics (which are beneficial for fleet assessment)

Fleet End-User Survey

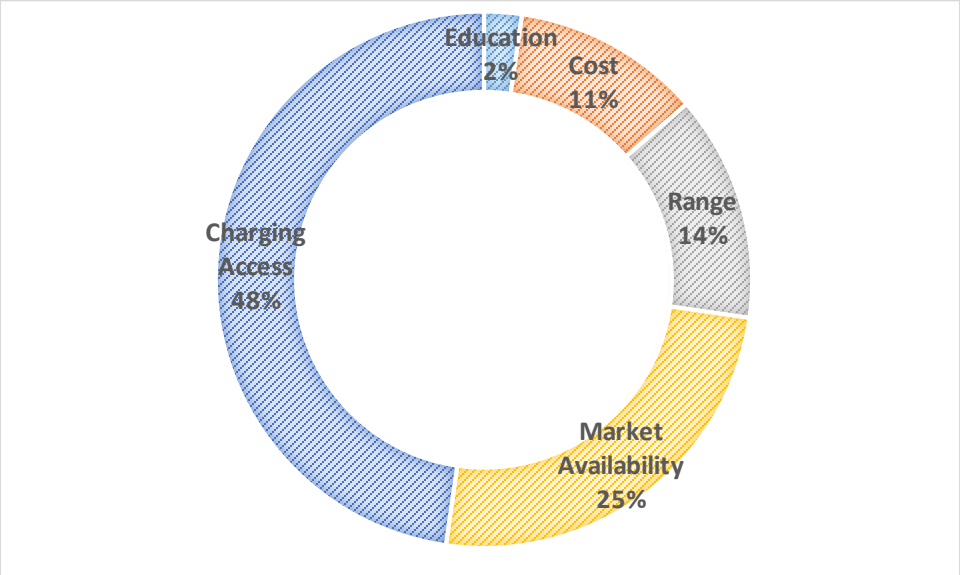
A fleet vehicle questionnaire was distributed to all fleet vehicle end-users within each of the four health organizations, to gather information from the departments and staff who regularly used the fleet vehicles. The intention of this survey was to gauge the overall perception of electric vehicles, as well as understand what concerns existed that will need to be addressed.

The questionnaire received 81 responses.

For more details see: Appendix M: Fleet Stakeholder Survey Responses

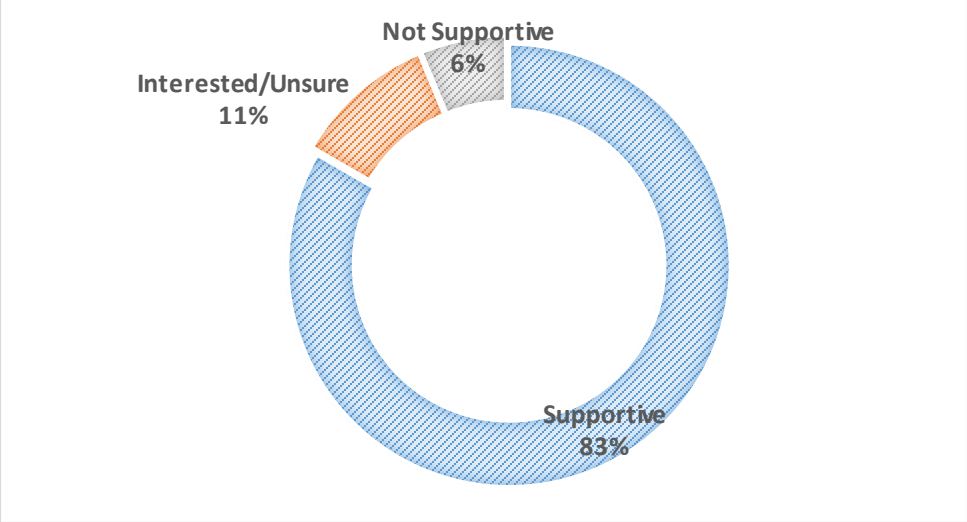
Greatest barriers to fleet electrification

What do you think would be the greatest barriers or concerns with transitioning to electric fleet vehicles?



General perspective on the transition to an electric fleet

What is your perspective, generally, on the transitioning to electric fleet vehicles?



Fleet Feasibility Assessment

Potential electric fleet vehicles were identified based on the vehicles that typically park at those sites, and the eligibility of those vehicles as potential electric candidates (see below criteria). This assessment was preliminary, and the LMHOs will require a more comprehensive and informative fleet assessment, in order to inform a Clean Fleet Plan.

Feasibility criteria:

- Vehicle type is light duty
- Has high operational costs (frequent repairs and maintenance)
- Is parked at a 'base' or in a single location for long periods of time (i.e. overnight)
- Will need replacement in the next five years
- Takes shorter trips, always returning to the base

The identification of these sites is a starting point for further investigation for fleet electrification.

See Appendix F: Fleet Feasibility Assessment

Based on the vehicle assessment, the following sites were recommended as potential sites to pilot electric fleet vehicles

Fraser Health	• Royal Columbian Hospital (5) • Surrey Memorial Hospital (1) • Timber Creek Tertiary Care at SMH (2)
Providence Health Care	• St. Vincent's Langara (1)
Provincial Health Services Authority	• Forensics Psychiatric Hospital (11)
Vancouver Coastal Health	• GF Strong (3)

BC Emergency Health Services

BC EHS is currently undergoing an electric feasibility study and exploring opportunities to pilot electric fleet vehicles (non-ambulance). There may be opportunity to support this initiative.

The work with BCEHS is ongoing, and should be a key consideration for both future EV installations, as well as new building development.

Due to their use for 24-hour service delivery, the only feasible type of charging for ambulances will be Level 3 chargers (Fast chargers).

Hospital Shuttle Program

The hospital shuttle service at Fraser Health, Providence, and PHSA is provided by a private coach service. This contract with is managed by IPS.

The Cambie Corridor Consortium Society is the transportation management association that manages the VCH Hospital shuttle program.

There are currently opportunities to engage with both, surrounding potential electrification of passenger vehicles,

Gaps and Opportunities

Through the stakeholder interviews and review of electric fleet vehicle best practices, several gaps were identified. The intention of identifying these gaps is to address the barriers that currently exist to fleet electrification in the Lower Mainland Health Organizations.

The opportunities identified are presented as options, not as prescriptive recommendations. These potential solutions should be explored, collectively, to determine which are the most feasible and effective pathways to an electric fleet.

Gaps	Opportunities
Leadership and Policy	
Absence of internal policy or formalized guidance/instruction from leadership. *The absence of instruction or guidance on how electric fleets should be addressed, with unclear roles and responsibilities.*	Pursue executive sponsorship to support the development of electric fleet strategy and policy, and establish the delineation of roles and responsibilities.
Communication	
Gaps in communication between different fleet stakeholders.	Form an electric fleet steering group to inform and guide the development of Clean Fleet Plans Continue to engage with stakeholders to address the identified gaps, explore opportunities to maintain ongoing communication between stakeholders. Ensure close communication with other (non-fleet) EV stakeholders.
Formalization and Management	
Data not available or not consolidated. *Fleet vehicle information often used for electric vehicle feasibility assessment (I.e. vehicle telematics, typical usage, parking location and users, etc.) is not collected or readily available.*	Conduct a formalized fleet assessment to inform a Clean Fleet Plan.

No fleet coordination/facilitation role at VCH (39 vehicles) or Providence (five fleet vehicles).	Seek guidance from executive leadership on roles and responsibilities within VCH.
Electric vehicles consideration or prioritization is not included in vehicle RfPs, and departments often rely on pre-approved vehicles to procure from (don't include electric vehicles).	Develop a Clean Fleet Plan and a Zero-Emissions Vehicle First Acquisition Policy.
Fleets coordinated differently between organizations and many departments manage their own vehicles. *Example: Providence and VCH do not have dedicated fleet coordinators.*	Consider the development of separate, parallel 'pathways' for each health organization within a wider regional electric vehicle strategy.
Availability and Access	
Electric vehicles on market don't always meet department needs.	Ensure that procurement and decision makers have access to information on market availability to anticipate EV procurement and the infrastructure needed to support. Develop a Clean Fleet Plan to establish clear guidance on when EVs will be procured.
Electric charging for fleet is not considered within capital project design and development.	Leverage opportunities to influence capital projects and develop policy for the inclusion of fleet EV charging (including Ambulance) in new construction. Ensure that fleet EV-readiness and EV best practices are embedded into capital project planning and design.
Additional Gaps	
The health organizations have low impact on leased sites, or core sites that are functionally operated by other health authorities (such as in PHSA). *Poses a barrier when exploring charging options for potential electric vehicles that park at leased sites.*	Continue to engage with building leasers and property managers to pursue EV charging opportunities. Once clear strategy has been developed, embed EV infrastructure and requirements into building leases and contracts.

No engagement with Population and Public Health	Involve Population and Public Health in the development of an EV strategy.
Limited awareness or education around EV fleet procurement, and use (resulting in hesitancy)	Provide educational opportunities and awareness within all levels of procurement process (such as EV fleet workshops for fleet end-users with BC Hydro).
Scope of fleet vehicles is limited (does not include staff personal vehicles, hospital shuttle, etc.)	Continue to engage with and explore opportunities for out-of-scope vehicles, such hospital shuttle, and ambulance.

APPENDICES

A. Electric Vehicle Charging Station Best Practices

Network Type

Level 2 charging stations fall into three categories, non-networked, closed network, and open network.

Non-networked stations have no smart features as they are not connected to a charging station management platform. Non-networked stations are often lower cost than networked station but lack the features that connectivity can provide.

Closed network charging stations are networked charging stations where the hardware is designed to operate only on the manufacturers network.

Open network is the use of the Open Charge Point protocol (OCPP).
It is recommended that all charging stations use an open network, through the use of an Open Charge Point Protocol (OCPP).
OCPP is protocol for communication between EV charging stations and a central management system, also known as a charging station network (comparable to cell phones and cell phone network). OCPP prevents charging stations from being 'locked in' to a single network. An OCPP charging station is accessible by any management system or charging network.

The latest version of OCPP is OCPP 2.0. As of 2019, OCPP has been a requirement of all new charging stations in the United Kingdom. To date, OCPP is not as highly adopted in North America. Flo and Chargepoint, commonly used service providers and network, do not follow OCPP nor provide OCPP charging stations.

Benefits of OCPP:

- Owner less vulnerable than if were reliant on a single supplier or service provider (i.e. to increased service fees, in the case of company closure, etc.)
- Owner has flexibility to switch providers when desired
- Access to multiple networks encourages manufacturers and network providers to compete on price, service, product features, and innovation.

Some organizations may choose to opt for a closed network, depending on existing regional charging station infrastructure, established relationships, or comfort based on positive previous experience or reputation of closed network companies.

Electrical Feasibility Studies

Electrical feasibility studies will need to be conducted prior to the installation of electrical charging stations. In addition to the electrical assessments provided by EV charging station services providers, all projects should engage with an electrical engineer to conduct an electrical feasibility study.

Scope of Work

- Conduct load analysis to estimate available capacity of existing electrical distribution system (From BC Hydro data, and data for temporary power meters). Please provide a separate line item in your fee table summary for load analysis (with temporary meters)

- Provide charging options assessment (where charger can be located, how many can be installed, load sharing availability, etc.)
- Provide cost estimates for deployment options
- Provide marked-up electrical drawings
- Provide support for completion of rebate documentation (list of applicable rebates, as well as support to apply for, if applicable)

Additional information that would benefit the project includes:

- Total project cost (including infrastructure upgrades)
- Annual fuel savings (GJ & $)
- Annual electricity increase (kWh & $)
- Total annual avoided emissions (tCO2e/year)
- Persistence (life of assets)

Complete Charging Solutions

It is recommended that projects employ the services of a complete charging solutions provider.

Scope of complete service includes:

- Planning and Design
- Procurement
- Installation
- Network Operations
- Infrastructure maintenance

It is recommended that only limited or select providers be used for all staff and public charging stations within a health authority.

- Consistent user experience
- Reduced barriers to monitoring and reporting
- Opportunities to bundle service agreements and warranties

User Experience

To avoid the need to have multiple EV service provider apps, charging stations should utilize a web-based app (that can be accessed through RFID cards or QR codes).

Consistency of signage, communications, as well as charging station management should be maintained between different sites and, if possible, between different health organizations.

Fleet Vehicles

- Make sure vehicles are equipped with standard charging connectors:
    - J1772 connector Level 2 (208/240V)
    - J1772 connector Combo (for fast charging)
    - CHADeMO (for fast charging)

Light duty vehicles on the market with MRSP and range data: http://www.emotivebc.ca/wp-content/uploads/2020/09/Electric-Vehicles-in-BC.pdf

B. Electric Vehicle Charging Fees

Purpose of EV Charging Rates

- Encourage turnover
- Cost-recovery
- Source of revenue
- Encourage EV etiquette and promote efficient charger use (I.e. Charge at home and top-up at work)

General Best Practices

- Rates should be easy to understand and predictable (i.e. should reflect similar rates in the area).
- Rates should be transparent. Programs that rely on the price signals inherent in the rate design to deliver grid and user benefits should ensure users actually see those price signals. If signals are not passed through to the drivers who decide when to charge, then charging behaviours will not be affected and neither grid nor use will benefit (I.e. Communicate reduced charging time at peak times)
- Rates should be designed with end-users in mind.
- Schedule a fee revision renewal annually to look at EV behaviour and opportunities to influence.

Recommendations:

- Use time-of-use charging, with greater prices for 'peak' hours
- Align prices with local or regional rates
- Costs should be greater than the cost of electricity (for cost-recovery, and also to encourage user to charge at home, if possible)
- Cost should not be a barrier to EV adoption, since some users may not have access to charging other than at work
- Charging rates should encourage turnover of EVs, and should also minimize, or moderate building electrical demand

Special Considerations for Health-care staff

Some staff may not be able to move their vehicle, due to work requirements. Charging fee policies need to be stringent enough to encourage turnover, but also flexible enough to accommodate some clinical care staff. One option is to build in ceiling cost (i.e. $10-$20) for staff who are unable to move their vehicle. It may also be decided that special considerations are made (i.e. additional fees are waived) for clinical care staff.

Types of EV Charging Rates

Dynamic vs Flat

Dynamic rates encourage turnover and de-incentivizes charging during peak hour. Flat fees remain constant.

1. Time-Based Fees

Vehicles are charged per time of use.

Benefits

- This model of payment is familiar to drivers (similar to a parking meter)
- This has been the most commonly adopted rate design throughout Metro Vancouver (Appendix C: Municipal Electric Vehicle Charging Rates within British Columbia).

Disadvantages

- There is not a direct correlation between the fee and the amount of charge a vehicle will receive (I.e. Vehicles with a slower charging battery may not receive the same amount of energy)

2. Volumetric-Bases Fees

Vehicles are charged based on the amount of electricity that is consumed. Currently, no EV charging stations have been approved by Measurement Canada to provide electricity for compensation. If charging stations acquire approval, volumetric fees may become a feasible option for EV charging providers.

Benefits

- There is a direct correlation between what user are paying for and the amount of charge they are receiving

Disadvantages

- Does not encourage turnover (fees not accrued if vehicle overstays/is fully charged)
- Total fee may be more difficult to predict, on the user-side (I.e. fee per kWh, vs. time)

3. Special Circumstances - Critical Peak Pricing

If there is a known upcoming event that places high electrical demand on buildings, extremely high prices can be used to de-incentivize any use during a time when a system is most stressed. These high prices occur during a small number of event hours per year. Customers typically received notification the day prior (i.e. message to notify that pricing will be ten times higher than the average rate on that particular day). Additionally, charging stations can be turned off, or reduced in number during these events (as long as a notice of closure is communicated in advance).

C. Municipal Electric Vehicle Charging Rates within British Columbia

Location	Fee
Abbotsford	none
Bella Bella	none
Bella Coola	none
Burnaby	Level II: $2/hour (6am-10pm) $1/hour (10pm-6am)
Chilliwack	none
Cloverdale	none
Coquitlam	$1/hour for first two hours, $5/hour after (+parking fee)
Delta	Proposed $1/$2/hour
Gibsons	none
Hope	none
Kelowna	none
Langley	Level II: $1/hour for first two hours ($3/hour after); Level III: $16/hour ($0.27/minute) for 40 min time limit
Maple Ridge	None
New Westminster	Level II: Dedicated circuit: $2/hour, Shared circuit: $1/hour, Level III: $16/hour ($0.2667/minute)
North Vancouver (City)	Level II: $2/hour, $1/hour - load managed (evening and overnight free); Level III: $.20 per min (24 h/day) ,
Port Coquitlam	Level II: $1/hour (first two hours, $5/hour after
Port Moody	Level II: $0.50-$1/hour for first four hours, then $5/hour; Level III: $12/hour
Powell River	none
Richmond	Level II: $2/hour for first two hours, $5/hour after; Level III: $8/hour at 25kW station, $16/hour at 50kW station
Saanichton	Level II: $1/hour (three hour time limit)
Sechelt	none
Squamish	Level III: $.12/minute at 25kW (BC Hydro station)
Sunnybrook Health Services Centre	Level II: $1 as connection fee, free for the first four hours, $0.25 for each hour afterwards.
Surrey	none
Vancouver	Level II: $2/hour (+parking fee); Level III: $0.26/minute ($16/hour) (+parking fee)
Victoria	Level II: $1/hour (+parking fee)
West Vancouver	none/free
Whistler	Level II: $1/hour, Level III: $0.35/kWh (minimum $2 fee)
White Rock	none

D. Municipal and Regional Electric Vehicle Requirements and Strategies

This document is a summary of municipal or regional requirements that impact the municipalities or regions within which the Lower Mainland Health Organizations own or operation health-care facilities.

Zoning: Health-care facilities are, in general, not included within electric vehicles zoning requirements. (For example, Vancouver General Hospital is zoned as a "Comprehensive Development", and would be exempt from any Residential or Commercial Zoning Bylaws; similarly, Hilltop House in Squamish is zoned as "Institutional")

Energized Outlets: The majority of municipal and regional bylaws specify that parking spaces feature an energized outlet capable of providing Level 2 charging, but not the inclusion of the charging station itself (Figure 4). An energized outlet is defined (in general) as a connected point in an electrical wiring installation at which current is taken to supply utilization equipment. An energized outlet can take the form of an outlet box with a cover or an electric receptacle. Level 2 charging means a Level 2 electric vehicle charging level as defined by SAE standard J1772.

Figure 4 Examples of equipment reqired to 'energize' parking stalls, or make 'EV-ready'

Municipal and Regional Electric Vehicle Requirements

Municipality or District	Requirement Type	Scope	Requirement	Link
Burnaby	Zoning Bylaw	Residential - Multi-unit	100% parking spaces for dwelling units shall be L2 EV-ready (doesn't include charging station)	Link
		Residential – Single family	100% parking spaces for dwelling units shall be L2 EV-ready (doesn't include charging station)	Link
Chilliwack	Zoning Bylaw	Residential - Multi-unit	100% parking spaced have L2 electrical conduit to all stalls (no outlets), 25% stalls have EV charging stations	Link
		Residential – Single family, Townhomes	One L2 EV-ready per unit	Link
City of North Vancouver	Zoning Bylaw	Residential – Multi-family	100% parking stalls have L2 EV charging stations	Link
		Non-Residential	45% stalls must have L2 EV charging stations (35% - workplace, 10% - on the go/visitor)	Link
Coquitlam	Zoning Bylaw	Residential - Multi-unit	100% stalls must be L2 EV-ready	Link
		Residential – Single family	One L2 EV-ready stall per unit	Link
Delta	Zoning Bylaw	Residential - Multi-unit	20% parking stalls have L2 or are EV-ready	Link
		Mixed-Use	With more than six dwelling unit: 20% parking stall have L2, or are EV-ready	Link
District of North Vancouver	Policy	Residential - Multi-unit	100% of parking stalls are L2 EV-ready	Link
		Commercial and Industrial	20% of parking stalls (not including accessible parking) are L2 EV-ready. 100% of accessible stalls are L2 EV-ready	Link
Langley	Zoning Bylaw	Residential - Multi-unit	One L2 EV-ready stall per dwelling unit (1 stall per four for seniors housing)	Link
		Residential – Single family	One L2 EV-ready stall per dwelling unit	Link
Maple Ridge	Amended Bylaw	Residential - Multi-unit	One L2 EV-ready stall per unit	Link
		Residential – Single family	One L2 EV-ready stall per unit (excluding visitor)	Link
		Commercial	10% of parking stalls L2 EV-ready (when there are 10+ parking stalls)	Link
Mission	Bylaw Proposal	Residential - Multi-unit	100% parking stalls L2-EV ready	Link

New Westminster	Bylaw	Zoning Residential - Multi-unit	100% of parking spaces must be L2 EV-ready (in buildings with at least one residential unity)	Link
		Residential – Single family	100% of parking spaces must be L2 EV-ready	Link
Port Coquitlam	Zoning Bylaw	Residential - Multi-unit	Not common parking: One L2 EV-ready stall per unit (when not common parking area). Common parking: Separate single utility electricity meter and disconnect provided in line with electrical panels intended to provide for charging of EVS	Link
		Residential – Single family	One L2 EV-ready stall per unit (when not common parking area)	Link
		Commercial, Mixed Use	Separate single utility electricity meter and disconnect provided in line with electrical panels intended to provide for charging of EVS	Link
Port Moody	Zoning Bylaw	Residential - Multi-unit	100% of parking stalls L2 EV-ready (excluding visitor)	Link
		Residential – Single family	100% of parking stalls L2 EV-ready (excluding visitor)	Link
		Commercial	20% parking stalls L2 EV-ready	Link
Richmond	Zoning Bylaw	Residential - Multi-unit	100% of parking stalls L2 EV-ready (excluding visitor)	Link
		Residential – Single family	100% of parking stalls L2 EV-ready (excluding visitor)	Link
District of Central Saanich	Zoning Bylaw	Residential - Multi-unit	1.5 EV-ready stalls per unit plus 0,25 EV-ready stalls per unit (for visitor parking)	Link
		Residential – Single family	100% units L2 EV-ready	Link
		Commercial	Various requirements, depending on Land-use category. Hospitals Acute Care: 5% L2 EV-Ready per bed, Min 1 EVSE per 12 bed)	Link
Squamish	Zoning Bylaw	Residential - Multi-unit	TBD	
Surrey	Zoning Bylaw	Residential – Single Family	100% parking stalls L2 EV-Ready	Link
		Residential – Multi-unit	50% visitor parking stalls L2 EV-Ready	Link
		Commercial	20% of parking stalls L2 EV-Ready	Link

Vancouver	Building Bylaw	Residential – Single Family	One L2 EV-ready stall per unit	Link
		Residential – Multi-unit	20% of stalls must be EV-ready	Link
		Commercial	10% of stalls must be EV-ready (45% in 2022)	Link
Victoria	Zoning Bylaw	Residential – Single Family	One L2 EV-ready stall per parking stall	Link
		Residential – Multi-unit	One L2 EV-ready stall per parking stall	Link
		Commercial	5% of stalls must be EV-ready	Link
West Vancouver	Council Resolution	Residential – Multi-unit	10% of stalls must be EV-ready	Link
White Rock	Zoning Bylaw	Residential – Multi unit	10% of stalls must be EV-ready	Link
		Commercial	10% of stalls must be EV-ready	Link

Municipal and Regional Electric Vehicle Strategies

Municipality/District	Strategy	Link
Abbotsford	Green Fleet Strategy	https://abbotsford.civicweb.net/document/55530
City of North Vancouver	Electric Vehicle Strategy	
Delta	Electric Vehicle Strategy - June 2020	https://delta.civicweb.net/document/197475
Gibsons	Sunshine Coast Electric Vehicle Charging Plan	https://www.sechelt.ca/Portals/0/public%20document%20library/Public%20Notices/2012-12-05%20EV%20Charging%20Plan.pdf
Kelowna	Community Low-Carbon Mobility Strategy: Electric Vehicles and E-bikes	https://kelownapublishing.escribemeetings.com/filestream.ashx?DocumentId=29928
Langley	Low Carbon Mobility Plan	https://www.tol.ca/news/low-carbon-mobility-plan/
Sechelt	Sunshine Coast Electric Vehicle Charging Plan	https://www.sechelt.ca/Portals/0/public%20document%20library/Public%20Notices/2012-12-05%20EV%20Charging%20Plan.pdf
Surrey	Surrey Electric Vehicle Strategy	https://www.surrey.ca/services-payments/parking-streets-transportation/electric-vehicles/electric-vehicle-strategy
Vancouver	EV Ecosystem Strategy	https://vancouver.ca/files/cov/EV-Ecosystem-Strategy.pdf

Victoria	Capital Region Local Government Electric Vehicle + Electric Bike Infrastructure Planning Guide	https://www.crd.bc.ca/docs/default-source/climate-action-pdf/reports/infrastructure-planning-guide_capital-region-ev-ebike-infrastructure-project-nov-2018.pdf?sfvrsn=d767c5ca_2

E. Transportation Accessibility Assessment

Assessment methodology

Points were given based on proximity to a cycling network most are comfortable with (as defined by Metro Vancouver), proximity to a Frequent Transit Network (as defined by Translink), presence of Level 2 charging stations on site, as well as density of Level 2 charging stations in the areas surround the site.

This methodology was based on one used by Bunt & Associates Transportation Planning and Engineering for the 2018 Fraser Health Transportation Demand Management Plan. The Bunt methodology only included public transit within its scope, whereas this assessment includes access to cycling networks, as well as access to EV charging stations.

Used a point system to score transportation accessibility based on

- Presence of Level 2 charging stations on site
- Density/availability of public charging stations near to the site
- Proximity to a Frequent Transit Network
- Proximity to a safe and comfortable cycling network

Assessment limitations

Using this method of assessment to direct electric vehicle installation in not without limitations. This score does not consider:

- Demand for electric vehicle charging
- Size of facility
- Number of FTE (Full time equivalent) staff

Additionally, greater weight is put on transit and cycling network access, than on access to on-site, or nearby charging stations. While this scoring can be used to understand more about transportation accessibility, these other components also need to be considered in discussion around site selection for future EV installations. For example, Richmond Hospital, despite having the largest EV charging installation in the province, scored low on the assessment due to low access by cycling and public transportation. While this scoring is useful and informative, the results need to be considered with the greater context of each site and its transportation requirements.

Outcome of site transportation assessments

Based on the scoring of the individual categories for each site, each site was awarded a transportation accessibility score. A low score indicates that the site is not easily accessible by a diverse range of transportation options. Low scores within each health organization are shaded blue. A high score indicates that the site is accessible by a diverse range of active and clean transportation options.

Facility Size, FTE, and Transportation Accessibility Score for core sites within the Lower Mainland Health Organizations. These are all factors that need to be considered when prioritizing sites for EV installation assessment and implementation. Note that some sites do not have available FTE data (left blank).

Fraser Health			
Site	**Usable facility space** (m^2)	**Site FTE**	**Transportation Accessibility Score** (0-low, 11-high)
Abbotsford Hospital (incl. Cancer Centre)	62,258	1475	1
Arbutus Place	1,640		1
Burnaby Hospital	48,089	1156	10
Chilliwack General Hospital	30,853	718	1
Chilliwack Health Centre (CGH)	2,976		0
Creekside Withdrawal Management Centre	2,729		4
Czorny Alzheimer Centre	6,393		0
Delta Hospital	13,284	373	1
Eagle Ridge Hospital	24,392	718	6
Felburn Care Centre	4,045	100	7
Fraser Canyon Hospital	7,677	100	2
Heritage Village	5,776	79	0
Jim Pattison Outpatient Care	19,941	493	4
Langley Memorial Hospital	37,751	968	1
Maple Ridge Treatment Centre	2,323		4
Mission Memorial Hospital	22,064	308	0
Cottage Worthington Pavilion	4,958		0
Parkholm Place (CGH)	3,582	6	0
Peace Arch Hospital	42,338	1072	1
Queens Park Care Centre	16,074	345	5
Ridge Meadows Hospital	23,238	763	6
Royal Columbian Hospital	64,747	2415	8
Surrey Memorial Hospital	115,112	3664	5

Timber Creek Tertiary Care Facility	4,539		5
Providence Health Care			
Core Site	**Usable facility space** (m^2)	**Site FTE**	**Transportation Accessibility Score** (0-low, 11-high)
Holy Family Hospital	10867	253	7
Mount Saint Joseph Hospital	21245	497	9
St. Paul's Hospital	111921	3254	11
St. Vincent's Brock Farhni Pavilion	5717	121	7
St. Vincent's Honoria Conway	5947	17	7
St. Vincent's Langara	9313	195	6
Youville Residence	6935	93	7
Provincial Health Services Authority			
Core Site	**Usable facility space** (m^2)	**Site FTE**	**Transportation Accessibility Score** (0-low, 11-high)
BC Cancer – Prince George	4,645	90	1
BC Cancer - Victoria	11,864	273	10
BC Cancer – Vancouver	29,335	1066	8
BC Cancer Research Centre - Vancouver	21,375		8
BC Children's & Women's Hospital	150,450	3301	9
Forensic Psychiatric Hospital	19,300	546	0
BC Cancer – Surrey	6,702	230	7
Sunnyhill Health Care Centre	8,318	90	8
Vancouver Coastal Health			
Core Site	**Usable facility space** (m^2)	**Site FTE**	**Transportation Accessibility Score** (0-low, 11-high)
Berkley Care Centre	14,602	153	3
Cedarview Lodge	6,990	86	1
Dogwood Lodge	4,943		9
George Pearson Centre	17,119	191	7

GF Strong	19,306	262	7
Lions Gate Hospital/ Evergreen / HOpe Centre	68,223	1442	8
Margaret Fulton Adult Day Care	2,442		6
Minoru Residence	11,477	223	6
Powell River/Willingdon Creek Village	21,484	179	5
Bowling Green Children's Center	496		5
Richmond Hospital	34,076	885	2
Richmond Lions Manor	4,604	95	8
Sechelt Hospital North & South Tower/Totem Lodge	13,730	219	1
Shorncliffe Intermediate Care	2,946		3
Squamish Hospital / Hilltop House	11,449	85	2
Sumac Place	1,442	34	1
UBC Djavad Mowafaghian Centre for Brain Health	15,764		10
UBC Hospital	68,705	681	10
Vancouver General Hospital	247,591	4340	8
Gordon and Leslie Diamond Centre	33,878		7
Whistler Health Care Centre	2,755	45	5

Scoring breakdown

Electric Vehicle Charging Stations

Points were given to sites, based on the presence of Level 2 staff charging stations on site, as well as the density of public charging stations near to the site (within a ten minute drive).

Transit and Scoring

"Frequent Transit Service" or FTN describes transit services with at least 15-minute frequency coverage for at least 15 hours of the day, 7 days per week. FTN service levels are considered the minimum service levels to achieve a good mode split to transit generated by adjacent development.[11]

[11] Translink Frequent Transit Network

Research has indicated that auto use is lower for residents and businesses in close proximity to high quality transit services (400m for Bus services and 800m for Rail services). Beyond 800m from Rail stations, mode share to transit declines (Source: Bunt Engineering)

The scoring is based on the distance of health-care facilities from a FTN, within Metro Vancouver.

Cycling
The cycling methodology is adapted from the Transit Accessibility Score Methodology used by Bunt Methodology, and scores the distance of health-care facilities from a cycling network that most are comfortable with.[12]

EV Charging Stations (off-site)	
2 points	High access to public charging stations near to the site (within a ten minute drive)
1 points	Moderate access to public charging stations near to the site (within a ten minute drive)
0 points	No/minimal public charging stations near to the site (within a ten minute drive)
EV Charging Stations (on-site)	
1 point	Level 2 staff charging stations are available on site
0 point	Level 2 staff charging stations are not available on site
Transit Accessibility Scoring	
4 points	Within 100m walking distance of an existing FTN Bus route, or 400m walking distance of a Rail station
3 points	Within 101m to 200m walking distance of an existing FTN Bus route, or 401m to 800m walking distance of a Rail station
2 points	Within 201m to 400m walking distance of an existing FTN Bus route, and >800m walking distance of a Rail station
1 points	Within 401m to 800m walking distance an existing FTN Bus route, and >800m walking distance of a Rail station
0 points	>800m walking distance of an existing FTN route, and >800m walking distance of a SkyTrain Station
Cycling Accessibility Scoring	
4 points	Within 500m cycling distance of a well-connected cycling network that is comfortable for most station
3 points	Within 500m cycling distance that is comfortable for some, 1km cycling distance of a well-connected cycling network that is comfortable for most

[12] Metro Vancouver Cycling Maps

2 points	Within 500m cycling distance that is not comfortable for most, 1km cycling distance from a well-connected cycling network that is comfortable for most
1 points	Within 500m cycling distance that is not comfortable for most, 1km cycling from cycling network that is comfortable for some.
0 points	Greater than 800 m from any cycling network

Fraser Health

Site	EV on-site	EV off-site	Transit	Cycling	Total Score (0-11)
Abbotsford Hospital (incl. Cancer Centre)	1	0	0	0	1
Arbutus Place	0	0	0	1	1
Burnaby Hospital	10	1	4	4	10
Chilliwack General Hospital	2	0	0	0	1
Chilliwack Health Centre (CGH)	0	0	0	0	0
Creekside Withdrawal Management Centre (at SMH)	0	1	2	1	4
Czorny Alzheimer Centre	0	0	0	0	0
Delta Hospital	0	0	0	1	1
Eagle Ridge Hospital	0	0	4	2	6
Felburn Care Centre	0	0	4	3	7
Fraser Canyon Hospital	1	1	0	0	2
Heritage Village	0	0	0	0	0
Jim Pattison Outpatient Care	0	0	2	2	4
Langley Memorial Hospital	2	0	0	0	1
Maple Ridge Treatment Centre	0	0	4	0	4
Mission Memorial Hospital	0	0	0	0	0
Cottage Worthington Pavilion	0	0	0	0	0
Parkholm Place (CGH)	0	0	0	0	0
Peace Arch Hospital	0	0	0	1	1
Queens Park Care Centre	0	1	0	4	5

Ridge Meadows Hospital	4	0	4	1	6
Royal Columbian Hospital	7	1	4	2	8
Surrey Memorial Hospital	14	1	2	1	5
Timber Creek Tertiary Care Facility (at SMH)	0	1	3	1	5

Providence Health Care

Site	EV on-site	EV off-site	Transit	Cycling	Total Score (0-11)
Holy Family Hospital	0	0	3	4	7
Mount Saint Joseph Hospital	0	1	4	4	9
St. Paul's Hospital	6	2	4	4	11
St. Vincent's Brock Farhni Pavilion (C&W)	0	1	2	4	7
St. Vincent's Honoria Conway	0	1	2	4	7
St. Vincent's Langara	0	1	1	4	6
Youville Residence	0	1	1	4	7

Provincial Health Services Authority

Site	EV on-site	EV off-site	Transit	Cycling	Total Score
BC Cancer – Prince George	0	1	0	0	1
BC Cancer - Victoria	0	2	4	4	10
BC Cancer – Vancouver	0	1	3	4	8
BC Cancer Research Centre - Vancouver	0	1	3	4	8
BC Children's & Women's Hospital	1	1	3	4	9
Forensic Psychiatric Hospital	0	0	0	0	0
BC Cancer – Surrey (at SMH)	1	1	2	4	8

Sunnyhill Health Care Centre (C&W)	0	1	3	4	8

Vancouver Coastal Health

Site	EV on-site	EV off-site	Transit	Cycling	Total Score
Berkley Care Centre (North Van)	0	0	0	3	3
Cedarview Lodge (North Van)	0	0	0	1	1
Dogwood Lodge (George Pearson)	0	1	4	4	9
George Pearson Centre	0	1	2	4	7
GF Strong	0	1	2	4	7
Lions Gate Hospital/ Evergreen / HOpe Centre	1	0	4	3	8
Margaret Fulton Adult Day Care	0	0	2	4	6
Minoru Residence (Richmond)	0	0	4	2	6
Powell River/Willingdon Creek Village	0	1	0	4	5
Bowling Green Children's Center (Richmond)	0	0	3	2	5
Richmond Hospital	1	0	0	1	2
Richmond Lions Manor	0	0	4	4	8
Sechelt Hospital North & South Tower/Totem Lodge	0	1	0	0	1
Shorncliffe Intermediate Care (Sechelt)	0	1	0	2	3
Squamish Hospital / Hilltop North & South House	0	0	0	2	2
Sumac Place (Gibsons)	0	1	0	0	1
UBC Djavad Mowafaghian Centre for Brain Health	0	2	4	4	10
UBC Hospital (Koernor, Purdy, Detwiller)	0	2	4	4	10

Vancouver General Hospital	1	1	2	4	8
Gordon and Leslie Diamond Centre (VGH)	0	1	2	4	7
Whistler Health Care Centre	0	1	0	4	5

F. Fleet Vehicle Assessment

See Excel Spreadsheet *Appendix F: Fleet Vehicle Assessment*

G. Electric Vehicle Incentives

West Coast Electric Fleets Pledge

In order to qualify for any fleet rebates or incentives offered through CleanBC, organizations must sign the West Coast Electric Fleets Pledge to the "Express Lane" Level. This level required organization to commit to at least 10% ZEVs for all new fleet vehicle procurement, and to annually revisit the pledge to consider a higher ZEV procurement goal.

Currently, none of the Lower Mainland Health Organizations have signed this pledge.

More Information

Federal Programs

NRCan Zero Emissions Vehicle Program (ZEVIP)

- Fifty percent (50%) of Total Project Costs up to a maximum of five million dollars ($5,000,000) per project and up to a maximum of two million dollars ($2,000,000) per project for Delivery Organizations.
- RFP for program has closed (for this round of funding)

More Information

Provincial Programs

CleanBC - Go Electric Fleets

- Support public and private light-duty fleets transition to zero-emissions vehicles.
- Up to 40 hours of ZEV Fleet Advisor Services;
- Up to $10,000 in rebates for telematics tools and a ZEV Fleet Assessment;
- Up to $5,000 in rebates for Facility Planning Assessments;
- Up to $20,000 in rebates for electrical infrastructure upgrades to support fleet EV charging;
- Up to $2,000 in rebates for the purchase and installation of Level 2 charging stations;
- Up to $50,000 in rebates for the purchase and installation of Fast chargers;
- Training sessions and webinars; and
- Resources and tools via the West Coast Electric Fleets Toolkit.

More Information

Clean BC - Special Use Vehicles Incentive Program

- Sub-program of Go-Electric Fleets
- Designed for speciality vehicles, such as motorcycles, low-speed vehicles, electric cargo bicycles, utility vehicles, and medium- and heavy-duty vehicles.
- Medium and heavy-duty vehicles, a maximum of $100,000 or 33% of the purchase prices (whichever is lower).
- Utility vehicles - $2000
- Leased vehicles – eligible for 33% of applicable rebate for 12-month term, and 100% for 24+ term.

More Information

Clean BC – Go Electric Vehicle Rebate Program

- For BC Hydro and Fortis BC customers
- $2000 rebate per Level 2 charging station (to maximum $14,000). Up to four separate locations.
- Five hours free support service from an EV Charging Station Advisor
- Rebates on electric vehicles (Up to $8000 per vehicle)

More Information

Corporate Supply Agreement

This supply arrangement is for Level 2 charging station supply, or supply and install, and applies to British Columbia government ministries and the broader public sector, including local government, grouped into six regions, for purchases up to $10,000.

More Information

Clean BC - Emotive Community Outreach Incentive Program

- Provides support and funding to B.C. communities, organizations, and local governments to assist them in delivering local/regional Emotive EV awareness campaigns
- Up to $5,000 to support EV outreach activities in their community, Up to $10,000 for a campaign that will span across multiple communities.

More Information

Other Incentives

High Occupancy Vehicle Access

The high occupancy vehicle (HOV) lane incentives came into effect March 2, 2016. Electric vehicle owners can apply for a free decal to travel in HOV lanes, even if they are the only vehicle occupant.

EV Workplace

An online resource by Metro Vancouver that offers information for employers on how to set up EVSE for their employees. www.evworkplace.ca

H. Electric Vehicles: Public and Community Health

Impacts of Internal Combustion Engines on Public Health

The greatest health impacts that internal combustion engines have, in comparison to zero-emissions electric vehicles, is a result of their production of fine particulate matter pollution.

Air pollution causes asthma, cardiovascular disease, impairs lung development in children, and has been linked to leukemia, and even lung cancer. Prevention is the most effective way to reduce these respiratory related illnesses. While higher air quality standards alone will not necessarily eliminate these illnesses, it is one prevention measure that has a significant ability to reduce premature mortality and benefit public health.

Health Benefits of Vehicle Electrification

Direct Impacts

Vehicle electrification in urban areas is an opportunity to achieve large public health benefits in the short term. Internal Combustion Engine (ICE) vehicles have significant impact on air quality and pollution, and therefore on population and public health. Even with the worst case electricity production (natural gas or other fossil fuels), EVs deliver substantial health benefits, as compared to internal combustion engines (Gai et al. 2020, Choma et al. 2020, Horton et al. 2021). These health benefits largely arise from the reduction in PM2.5 (fine particulate matter) attributable mortality. Many serious diseases are caused or worsened by poor air quality.

In urban centres, such as Vancouver, Montreal, and Toronto, marginalized groups, such as low-income, racialized, and Indigenous communities, are disproportionally exposed to high levels of air pollution, and is cumulative impacts (Giang and Castellani, 2020). While the cost of electric vehicle, as well as access to electric vehicle charging, is still a prohibitive barrier to ownership for many individuals and families, the reduction in air pollution resulting from a transition to EV ownership has the potential to have a greater impact on marginalized groups, due to the higher exposure rates.

Indirect Benefits

Increased public health reduces avoidable pressure on and use of the health care system and its resources. Vehicle electrification, in its prevention of premature deaths and avoidable illness, also comes with the downstream social benefits of reducing resource use and reliance. According to the Organization for Economic Co-operation and Development, a reduction in global economic output as a direct result of air pollution will be approximately $330 per person by 2060, and pollution-related annual health care costs in the U.S. will rise to $176 billion.

Electric Vehicle Charging and Health Care

Health care organizations across the United States and Canada have taken a collective stance in their support for the transition to electric vehicles.

In 2020, Health care representatives from across the Unites States wrote a letter to the U.S. Senate, asking for support the transition to electric vehicles, due to the significant impacts it would have on public health, as well as the environment.

The Canadian Coalition for Green Health Care, in collaboration with six other health care organizations in Ontario, has created the Zero-Emissions Vehicle Awareness Initiative, to increase the sector's understanding and capacity concerning charging infrastructure and to provide resources to assist those working to introduce electrification in their organizations.

Integrating Health in Plan Development

As health care organizations, the Lower Mainland health organizations have the ultimate responsibility to ensure that all plans consider and incorporate public and community health.

- From Planning and Community Health: A Practitioner's Handbook (2021), this includes:
- Public health practitioners be involved early in the process;
- Able to help shape the development of the plan;
- Health policy is integrated into the highest-level plans (Official Plans) to ensure effective implementation and compliance;
- Provide meaningful input and analysis;
- Contribute to implementation;
- Support evaluation.

Research Findings

Health and climate benefits of electric vehicle deployment in the Greater Toronto and Hamilton Area. Environmental Pollution (2020):

- 50 fewer premature deaths (25% EV penetration), 260 fewer premature deaths (100% EVs)
- If EVs are charged with renewable sources, electrifying all passenger vehicles can prevent 330 premature deaths per year (equivalent to $3.8 billion – 2016$CAD in social benefits)

Assessing the health impacts of electric vehicles through air pollution in the United States. Environmental International (2020):

- We find that electrification leads to large benefits, even with EVs powered exclusively by fossil fuel plants.
- Reductions in PM2.5 attributable mortality
- Vehicle electrification in urban areas is an opportunity to achieve large public health benefits in the short term.

Effect of adoption of electric vehicles on public health and air pollution in China: a modelling study. The Lancet (2021):

- Widespread adoption of heavy-duty electric vehicles would reduce nitric oxide and fine particulate matter resulting in 562 fewer premature deaths than the non-electrified baseline scenario. Does not reduce carbon dioxide emissions because no emissions free electricity generation
- Adoption of light duty electric vehicles reduces carbon emissions but not as many pollutants (fewer air quality improvements, and avoiding premature deaths).

I. Electric Vehicles and Equity

An intention of this project was to outline how equity, inclusion and accessibility will be addressed at each phase of the project, and within a regional EV strategy.

Currently, there are still many barriers that exist to electric vehicle ownership:

- Higher up front cost than comparable internal combustion options
- Fewer re-sale/used options available
- Provincial and Federal rebates not available for re-sale/used options
- Low access to charging infrastructure, especially in urban centres.

Access to Charging

Equity within a community can be advanced by ensuring that infrastructure supports underserved populations, and by focussing on equal access, then proportionate distribution.

An electric vehicle strategy within the health regions should ensure that all staff have equal access to electric vehicle charging, and a focus should be placed on those facilities, communities, and regions in which access to EV charging infrastructure is less available.

Higher income communities, families, and individuals will be early adopters of EVs. However, now there is a need to consider access by those underserved communities that may not currently have access. As the price of vehicles decreases and EV market share increases, owning an electric vehicle in and of itself may be an option, but access to charging may not be.

This project used access as an initial consideration in the identification of potential EV charging installations. By considering context first (access to EV chargers, as well as alternative-to-driving transportation modes), we can ensure that access is at the forefront of this work, as opposed to demand by existing EV owners. This project has the capacity to fill access gaps, and mitigate the creation of 'charging desserts'.

Charging access may be lower in:

- Regions or communities with a higher proportion of renters (less access to home charging)
- Regions or communities that don't have access to public charging stations

Impact of Air Pollution

In urban centres, such as Vancouver, Montreal, and Toronto, marginalized groups, such as low-income, racialized, and Indigenous communities, are disproportionally exposed to high levels of air pollution, and is cumulative impacts (Giang and Castellani, 2020). While the cost of electric vehicle, as well as access to electric vehicle charging, is still a prohibitive barrier to ownership for many individuals and families, the reduction in air pollution resulting from a transition to EV ownership has the potential to have a greater impact on marginalized groups, due to the higher exposure rates.

J. Charging Station Etiquette and Communications (from Richmond Hospital)

Communication plan

Electric vehicle installation at Richmond Hospital

March 2021

Purpose

This communication plan outlines the strategy, tactics, and key messages to support the phased rollout of electric vehicle (EV) chargers in the Richmond Hospital parkade.

Background

As part of Vancouver Coastal Health's (VCH) 2020/2021 service plan, VCH is committed to taking steps to reducing our emissions by moving forward on a range of energy and emission reduction projects. Thanks to funding from the Carbon Neutral Capital Program (CNCP) and the Ministry of Health, Richmond Hospital will be installing 30 electric vehicle (EV) charging stations in the parkade to help reduce emissions.

The project will be rolled-out in phases starting April 19 with six EV stalls and increasing capacity based on feedback and demand. In total, 30 EV stall will be available—two of which dedicated to patients. All charging stations will have a four-hour maximum stay. All parking stall will be located on the ground floor of the Richmond Hospital parkade and will not require pre-registration from any staff or patients in order to use the charging system.

Goals

- To communicate the public health benefits of electric vehicles and how the new EV charging stalls will benefit VCH-Richmond employees, benefit the environment, and are aligned with overall VCH emission reduction strategies).
- To ensure staff and medical staff are aware of the etiquette surrounding the use of the EV stations.
- To mitigate any questions or concerns that may arise from the installation of the EV charging stalls, considering that parking is limited on the Richmond Hospital campus.

Audiences

Primary

- VCH-Richmond staff and medical staff
- Richmond SLT

Secondary

- Media
- VCH-wide staff and medical staff
- General public

Key messages

Overall benefits of EV and VCH sustainability goals:

- VCH is committed to reducing our emissions and supporting projects that provide environmental health benefits to our staff and our communities.
- To support our community in the transition to electric vehicles, VCH-Richmond is rolling out the largest installation of electric vehicle charging stations in the province.
- 35 per cent of greenhouse gas emissions in our region come from on-road transportation. The new EV charging stations will help support our staff and our community to transition to a more sustainable transportation method such as electric vehicle.
- Moving away from vehicles that burn fossil fuels to electric vehicles could significantly reduce air pollution exposure and the associated population health impacts.

EV charging etiquette and parking impact

- VCH-Richmond provides designated electric vehicle parking stalls for staff, medical staff and patients on a first-come, first-served basis in the Richmond Hospital parkade.
- Vehicles parked in these designated stalls must be electric vehicles charging and display a staff parking pass.
- Be smart with your charging time. Do not occupy a charging spot after you've finished charging or if charging is not needed.
- You wouldn't stop at the gas station every time you take your fuel-vehicle on the road, so why would you charge your electric vehicle every time? Be respectful and allow others to use the charging stations if you do not require a charge.
- There will be no loss to overall parking stall numbers in the parkade. The new EV parking staff will be rolled out in phases, based on demand from our staff and community. We have re-allocated parking stalls that were previously located throughout the parkade next to power outlets to a central location on the ground floor.

Suggested tactics

- VCH-Richmond staff/medical staff memo
- VCH news story
- Media pitch – earth day theme (largest installment of EV charging stations in B.C.)
- Tip sheet/etiquette for staff
- Talking points for parking attendants
- QA for managers and leaders
- Update information on vch.ca listing (parking section)
- Presentation to managers and frontline leaders
- Social media

Action plan

*based on April 19 launch

Timing	Activity	Audience	Responsibility	Status
April 12	Presentation	Managers and frontline leaders	Ashok, Kori	
April 13	QA	Managers and leaders	Tanya, Kori, Ashok, Sam	
April 15	Memo (attached etiquette tip sheet)	VCH Richmond staff and medical staff	Tanya, Kori, Ashok, Sam	
April 16	Update VCH.ca listing	General public	Tanya, web team	
April 19	VCH news story	VCH staff	Tanya	
April 21	Media pitch – earth day	General public	Tanya, Public Affairs	
April 22	Social media posts – earth day	General public	Web team, Tanya	
Ongoing	Updates as more stalls are opened, revised QAs	VCH Richmond staff and medical staff	Tanya, Kori, Ashok, Sam	

Evaluation

- Use of EV charging stalls
- # and sentiment of questions from staff, medical staff (to managers or parking attendants)
- # and sentiment of comments on VCH news story
- # and sentiment of media stories

K. Charging Station Specifications for the Lower Mainland Health Organizations.

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1. General

1.1 REFERENCES

.1 Society of Automotive Engineers:
  .1 SAE J1722, Electric Vehicle conductive Charge Coupler.
  Underwriter Laboratories:
  .2 UL® 2331, Personnel Protection Systems for Electric Vehicle Charging circuit.
  .3 UL 2594 Electric Vehicle Supply Equipment.
  .4 UL 991, Standard for Safety Tests for Safety-Related Controls Employing Solid-State Devices.
.2 Canadian Electrical Code section 86 – Electric Vehicle Charging Systems.
  .1 NFPA® 101-2006, Life Safety Code.
.3 National Fire Protection Association:
  .1 NFPA 70 article 625 – Electric Vehicle Charging Systems
.4 LEED® Canada-NC 1.0, Credit 4.3, Alternative Transportation: Hybrid and Alternative Fuel Vehicles.

1.2 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 26 or 01 – Common Work Results – Electrical.
.2 Submit product data sheets for EV Charging Station. Include product characteristics and ratings, performance criteria, dimensions, limitations, compliance, listings and approvals, finish, and installation details.
.3 Manufacturer Instructions: Provide to indicate installation sequence, cleaning procedures and scheduled maintenance.
.4 User Manual: Include O&M manuals illustrating the modes of operation, user instructions, safety, precautions and standard operating instructions.

2. Product

2.1 EV CHARGING STATION Addenergie Core+

.1 Free standing cUL certified level 1 and 2 AC electric vehicle charging station. The EV charging station shall comply with the applicable requirements of all codes and standards listed in article 1.1 of this specification and shall be so listed and so marked legibly.
.2 Housing: NEMA 3R sun and heat resistant free standing bollard mount natural aluminum finish.
.3 Supply voltage: 208 VAC or 240 VAC
.4 Standby power: 10 W typical.
.5 Output charging power: 1.2kW to 7.2 kW Maximum
.6 Output Current: 6A to 30A

.7 Output charging connector: Shall be SAE J1772 EV connector on 5.48 m approved cable, and holster.
.8 Locking mechanism: to protect power insertion point and retain the EV charging cord to prevent theft during charging.
.9 Display bright, easy to read display for instructive, informative and protection alarm display.
.10 Card reader: ISO 15693, 14443.
.11 Ground Fault protection:
  .1 20 mA CCID with auto retry for level II
  .2 Three retries with 15-minute delay for both levels.
.12 Plug-Out detection:
  .1 Power terminated per SAE J1772™ specifications for level 2.
  .2 Algorithm to disengage power and notify the driver when a plug is removed.
.13 Over-current protection: To disconnect power at the charging device to prevent breaker trip at branch circuit panel. To have auto retry and driver notification.
.14 Charging complete detection: Algorithm to detect completion of EV charge and notify the driver.
.15 Power measurement: 2% at 15 minute intervals for both levels.
.16 Local Area Network: 2.4 GHz 802.15.4 dynamic mesh network.
.17 Surge protection: 6 kV at 3 KA.
.18 EMC compliance to FCC part 15 class A.
.19 Operating temperature: -30^{0}C to +50^{0}C, 95% non-condensing humidity.
.20 Terminal block temperature rating: 100^{0}C.
.21 To be Addenergie Core+ or alternate as approved by **Lower Mainland Health Care Organizations.**

2.2 SOURCE QUALITY CONTROL

.1 Factory tests shall be performed in accordance with the latest version of all applicable CSA, NEMA, UL and ULC standards.
.2 Factory test the EV Charging Station in accordance with manufacturer source quality control instructions including pilot and proximity pin resistance readings, cable insulation properties and ground fault interruptance testing.
.3 Notify the station owner in advance of the dates and times of the test. Include all costs associated with testing and or maintenance.
.4 Demonstrate successful results for the following tests:
  .1 Visually inspect all equipment for signs of damage or foreign materials as well as cleanliness of the installed system and any other safety related factors.
  .2 Mechanical Inspection:
    .1 Check all the power connections for tightness.
    .2 Check all the control wiring terminations and plugs for tightness or proper seating.

3. Execution

3.1 INSTALLATION

.1 Provide concrete base for pedestal or wall mount bracket for wall mounted application and install the unit as per manufacturer instructions in accordance with Canadian Electrical Code.
.2 Connect to branch circuit breakers as per submitted drawings.
.3 Provision station/stations and web portal access (provide training & orientation).
.4 Provide a permanent sign to read ELECTRIC VEHICLE CHARGING STATION and/or other parking signage, wrap and groundmarking as required by the organizations. Method of attachment shall be pre-approved by the station owner so as to have no deteriorating effect on ratings, performance and warranty of the unit.

3.2 FIELD QUALITY CONTROL

.1 Start-up shall be provided by a certified technician/integrator designated by the Lower Mainland Health Care Organizations. Start-up service shall be provided at no extra charge and shall include one visit to perform all procedures, test and verifications specified by manufacturer within the unit's installation, testing and verification manual. Electrum Charging Solutions shall also perform the following services:
  .1 Inspect installation prior to energizing as required.
  .2 Ensure EVSE are working as designed by the manufacture and are communicating on the network (where applicable).
.2 The following procedures and tests shall be performed by Field Service personnel during the startup:
  .1 Visual Inspection: Visually inspect all equipment for signs of damage or foreign materials as well as cleanliness of the installed system and any other safety related matters.
  .2 Mechanical Inspection:
    .1 Check all the power connections for tightness
    .2 Check all the control wiring terminations and plugs for tightness or proper seating.

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    .1 Check all the power connections for tightness
    .2 Check all the control wiring terminations and plugs for tightness or proper seating.

L. Environmental Impact of Electric Vehicles

Greenhouse Gas Emissions

Over the lifetime of battery electric vehicle, fewer greenhouse gas emissions will be produced than over the lifetime of an internal combustion engine (gas/diesel) engine (Figure 5).

Vehicle Production

Production of electric vehicles produces greater greenhouse gas emissions (primarily due to the lithium battery) than the production of internal combustion engines. EV production (and all technologies associated) provides opportunities for 'New shoring' – rather than disentangle existing supply chains, new, local supply chains can be rebuilt in a reasonable way.

China has high emissions manufacturing, due to coal powered manufacturing. Emissions of EV battery production could be cut 66% if they adopted manufacturing techniques used in America or Europe. Extraction process and production would be on par with ICE vehicles

Batteries are heavy, so more effort to making vehicles lighter (more energetically intensive)

Electricity Source

Because BC's electricity is almost completely renewable (95% from hydro), the production of greenhouse gas emissions, due to vehicle re-fuelling is minimal. The full emissions impact of expanded EV deployment depends on the carbon intensity of electricity production.

Lithium Batteries

Resource Extraction

Lithium is not scarce and the current reserves of metal are expected to be able to support conversion to electric vehicles to ~2050.

- More than half of lithium salt comes from the 'lithium-triangle': Argentina, Bolivia, Chile.
- Canada currently has ingredients to manufacture batteries, but will be a complex and challenging process, since it is a brand new industry for Canada and in competition with countries that are already doing it[13]
- Process uses a lot of water (large impact on surrounding ecosystems and farming)
- Cobalt and Nickel are also require for the batteries
    - Cobalt
        - Democratic Republic of Congo
        - Relatively easy to extract
        - Working conditions are of a concern
    - Nickel
        - Central Africa

Fuel Efficiency

[13] Electric Autonomy Webinar: Building a Canadian vision for an EV battery supply chain https://www.youtube.com/watch?v=4MhZWwWQS7g

Electric Vehicles have a much higher fuel conversation rate (i.e. efficiency); 59% - 62% of electric energy powers the vehicle (only 17-21% in ICE)

Battery Longevity

User education remains one of the best ways to increase battery longevity.

From Geotab:

- Degradation is increased by operating at full charge, or low charge
- Degradation increased by using Fast chargers often
- If the observed degradation rates are maintained, the vast majority of batteries will outlast the usable life of the vehicle
- Average battery loss was 2.3% per year
    - For an EV with a 240 km range, only 27 km were lost from range after five years of use

EV Battery degradation tool: https://www.geotab.com/fleet-management-solutions/ev-battery-degradation-tool/

End-of-Life

- Technology exists to recover 95% of a lithium battery (not necessarily the current practice)

Resources

- Electric Cars and Batteries: How will the world produce enough? (Nature, 2021)
- White Paper: A global comparison of the life-cycle greenhouse gas emissions of combustion engine and electric passenger cars (The International Council on Clean Transportation, 2021)
- The Electric Vehicle Outlook 2021 (BloombergNEF, 2021)

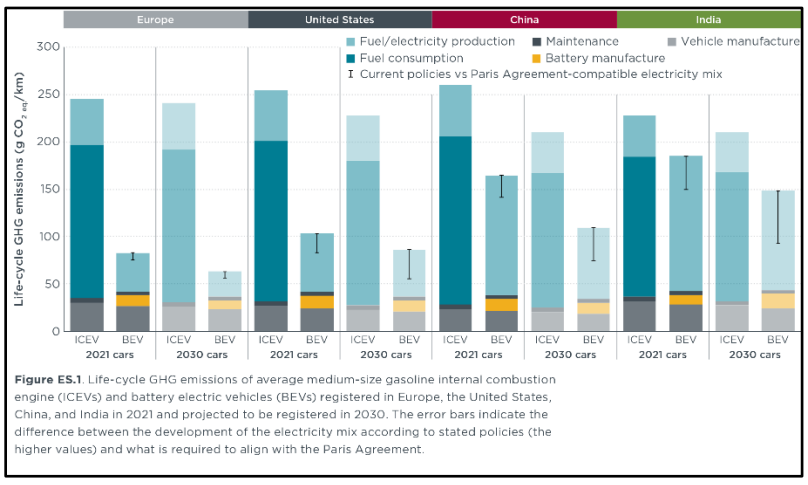

Figure ES.1. Life-cycle GHG emissions of average medium-size gasoline internal combustion engine (ICEVs) and battery electric vehicles (BEVs) registered in Europe, the United States, China, and India in 2021 and projected to be registered in 2030. The error bars indicate the difference between the development of the electricity mix according to stated policies (the higher values) and what is required to align with the Paris Agreement.

Figure 5 Life-cycle Greenhouse gas emissions from internal combustion engines and eletrical vehicles. Source: The International Council on Clean Transportation: White Paper (2021)

M. Fleet Stakeholder Survey Responses

A survey was distributed to all fleet vehicle end-users within the four Lower Mainland health organizations. Any strong negative responses or concerns are shaded grey. Survey responses were collected from July 9, 2021 until August 10, 2021. Responses to three of the survey questions are shown below. Responses of interest (I.e. strongly opposed, with unique insight, etc.) have been identified with the gray shading.

What is your perspective, generally, on the transitioning to electric fleet vehicles?

Response
I am in favour
never thought about it before. might be better for the lower mainland employees who drive in cities and now remote & isolated areas.
If we don't make the transition to green energy/transportation we will not meet our climate objectives.
Good
Love this ideea
open
If costs of leasing an electric car are similar to a gas vehicle there should not be an issue. If leasing an electric vehicle requires a much higher budget it would most likely not be an option for our program.
Think it's a great idea.
NOT FEASIBLY TO HAVE ALL ESCORT FLEET ELECTRIC
I think it is a fantastic idea and environmentally the most responsible thing to do.
Interesting
Fine
It is a good idea.
It is a great initiative, I think. however it would be good to have hybrids with charging capabilities as well. As this will allow longer trips to be made without charging if needed.
It's better for the future use, and maintenance.
Great idea.
Great idea if we could do it!
The fleet should be transitioned. Supprotive
It would be a good option as gas is currently very expensive
unsure- not convenient with fueling/recharge and how long it's going to last--- gas is predictable and convenient
not applicable to our site
I am in favour of this to help improve the environment.
We're overdue in looking after the planet.
Important and necessary step
it will be necessary in the future as gas vehicles are being phased out
Fine with me.
good if can be done with out effecting productivity
I am familiar with electric vehicles and for our purposes and requirements these vehicles would be more than adequate.

This would be fantastic if there were charging stations readily available.
Positive, with respect to the environmental impact, to reduce greenhouse gas emissions
Excellent idea.
In favour of it as long as the vehicle is big enough to suit our current needs. Must able to tow small trailer.
Not sure if they make large electric buses for transporting wheelchairs
I am a believer. I have had my electric car for 1 1/2 years, no issues, no regrets!
energy saving is good
If it will help with global warning like it is thought too....I think it is a wonderful idea. I am unsure of how it will work in our rural community.
I agree with the transition for financial reasons and environmental reasons.
I feel it is a great way to reduce the carbon footprint. It would reduce cost of fuel and engine maintenance.
That would be awesome!
support it if it meets our needs
I think it is great idea
For FMO, not a good time yet since there aren't EV's in the market that are well designed for heavy duty carrying load.
It would save on paying for gas. It would be a good transition ensuring there was a charging station for the vehicle on site
I think it would be great if possible
good idea
Bella Coola is not ready for electric vehicles yet
Great Idea
Any possible step that benefits the environment is a good transition :)
Excited at the prospect

How would transitioning to electric fleet vehicles impact your job duties or your department?

Response
I would welcome it if the functionality was there.
my only concern would be the lack of charging stations in remote locations, how long a battery charge is good for, ability to handle all weather types without running into electrical issues.
Helping the environment
IDK
I think it would be great overall, and good for the environment
None
Since there are charging stations at Red Fish it would not have an impact on daily routine, really.
Very minimally. Would probably save us money aside from the initial capital purchase costs.
WE COULDN'T TRANSPORT PATIENTS A LONG DISTANCE
There would be no impact to the job duties.
Need to charge every day
None

We will not be able to make longer trips if all vehicles are changed to EV.
It will be very easy for us. No need to gas up.
would have to make sure staff plug the vehicle in at end of day and ensure lights are off.
Little. Just needs to be plugged in.
Extra time to put on charge and take off charge as there is no charging station at our location
don't know
It wouldn't impact us - except improve things due to maintenance and fueling up. My understanding is electric vehicles have less moving parts to break down and do not require going to a gas station if a charging station is available at each location.
It would potentially make things easier. As it happens, we need to plan for fuel ups as we don't have a gas card for the vehicle.
None
not sure
no
not sure
Not at all
It would not impact it that much as maintenance of the Mini bus is done by an outside contracter who picks up the bus, services it and then returns it. It would mean less of our budget would need to be allocated for gas, repairs and quarterly checkups.
May require some initial orientation regarding use, how to charge up the vehicle etc.
It would not.
minimal impact
unsure
minimal. We would need to ensure the battery is large enough for medium distance drives and capacity to run a/c and the wheelchair lift.
It would make add to the job duties as it would have be monitored regularly.
Not at all
a charging station would need to be installed and staff would need to be oriented on how to plug in and disconnect charger
More hours finding and charging vehicle. If charging was accessible, little change
as long as it meets our needs (minivan for older 5-6 adults with room for wheeled walkers) and it can be charged easily, no impact that I'm aware of
No
Our only pick up truck may be required to carry heavy loads at times and there isn't an efficient pick up truck on the EV market at this moment. Existing charging station on our hospital ground is too far from the FMO shop area.
I don't think there would be an impact - it would be educating the staff members who use the vehicle
not sure
Would not.
No impact as long as it carries what we need.
Mindfulness on charging requirements only - developing new habits

What do you think would be the greatest barriers or concerns with transitioning to electric fleet vehicles?

Responses	Type
Needs to be a pick-up and there aren't any currently on the market that would meet our needs	Market availability
lack of charging stations in remote locations. Over night trips employees have for work purposes and no charging capabilities. Winter weather driving through mountain terrain.	Market availability Range
charging stations	Charging access
No inside parking, staff education,	Education
Costs	Cost
Nothing comes to mind. New facility our program moves into in October even has designated charging stations for electric vehicles. BCMHA currently doesn't, though.	
Supplying pick up trucks or cube vans that are electric and can tow / haul heavy loads.	Market availability
THE DISTANCE THAT WE TRANSPORT THE PATIENT	Range
I see no barriers	
Infrastructure	Charging access
Reliability for long distance trips	Range
The size of the vehicle required to transport large/heavy items.	Market availability
Some vehicles are needed to for longer trips and possible overnight stays as well. Not all sites we visit have EV charging stations.	Charging access Range
Charging station, need some work to do.	Charging access
no electric plug in currently in secure underground parking garage	Charging access
Availability of small EV buses	Market availability
Charging stations	Charging access
Battery running out and being stuck in traffic with a bus full of residents Not convenient to go to a charging station	Range Charging access
not enough gas stations for fueling/recharge	Charging access
finding a place to charge and/or providing a designated spot where only that vehicle can charge.	Charging access
The vehicle we have was only purchased a few years ago so it would not make sense financially to buy another in the short-term.	Cost
Cost.	Cost
cost of a new vehicle as this one was purchased through a fund raiser through VGH foundation; charging station in parking area would need to be installed	Cost Charging access
Finding places to plug in. Time taken to charge.	Charging access Time
cost	Cost
Well our sis a brand new donation so replacing it seems far fetched. Perhaps the next bus? Maybe in 10 to 15 years?	
finding a place to charge the vehicle in the community.	Charging access

Whether an electric light duty bus is suitable to transport 4 residents in heavy power wheelchairs for longer day trips. What is the maximum distance and time that the bus can be driven before the vehicle needs charging again? The mechanical lift to load resident wheelchairs onto the bus is battery operated - how is this impacted, if at all?	Market availability
Winter Driving 200 km round trips Squamish to Pemberton, and back. Ability to tow a small utility trailer.	Market availability Range
expense, maintenance	Cost
VCH policy Infrastructure (charging facilities)	Charging access Absence of policy
low usage	Low vehicle usage
The electric charging as this vehicle does not have a regular parking station. (overnight)	Access to charging stations
Decreased frequency of use of the van bus.	Low vehicle usage
No barriers at this site.	
Distance and charging availability...we currently park offsite	Charging access Range
no dedicated spot to add a charging station; no staff available to take to and return vehicle from city charging spots. Also our Toyota mininvan was purchased for about $40,0000 by a volunteer and dedicated to our program. Would we receive some sort of monetary compensation for the vehicle if it was sold/replaced?	Charging access Cost
size	Market availability
Frequency of usage, only occasionally and sporadically.	Low vehicle usage
ensuring that there are places to be able to charge the vehicle	Charging access
dedicated 'plug in' space; required refrigeration unit	Charging access
We have a passenger bus for resident outings	Market availability
No place to recharge in Bella Coola or Anahim Lake	Charging access
Charging	Charging access
The space required for our tools, materials, parts, etc.	Market availability

Additional Questions and Concerns

Sometimes the vehicles will be parked at locations overnight apart from the clinic – how will they be charged then?
Who would be paying to install the charging stations?
YES, CONCERNED THAT THE ELECTRIC VEHICLES CAN'T GO LONG DISTANCES AT THIS TIME
When is it gonna be approve? Can we get one, at least to try?
Our fleet vehicle is a pickup truck as we need the ability to be able to discard of items to our local dump and/or recycling facilitie(s)
Great survey, good luck