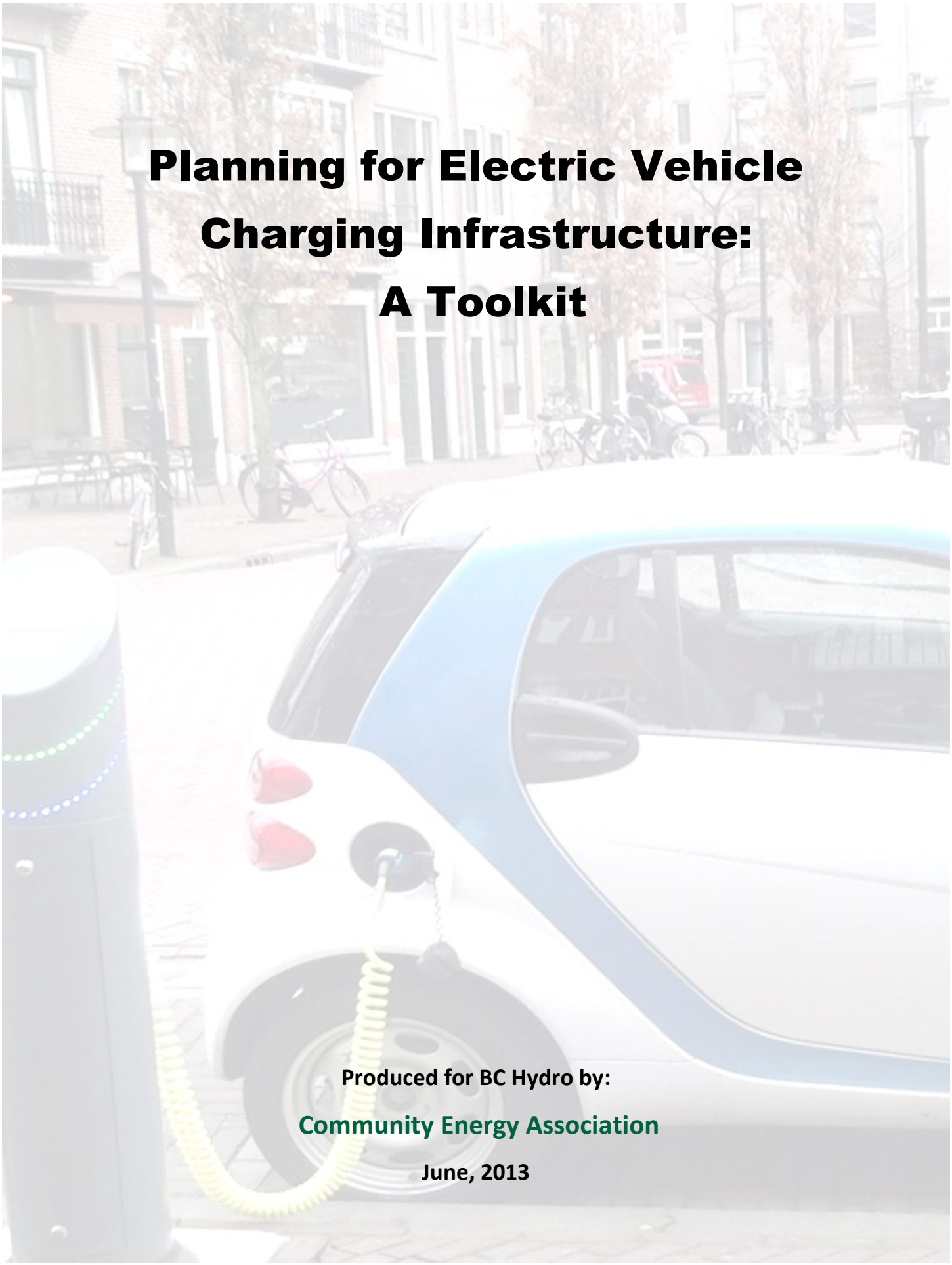

Planning for Electric Vehicle Charging Infrastructure: A Toolkit

Produced for BC Hydro by:

Community Energy Association

June, 2013

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Photo credit (front cover): An electric Smart Car being recharged at a municipal charging station in Amsterdam, Netherlands. (Photo: Wikimedia Commons)

Community Energy Association

Contents

List of Acronyms/Terms

Terms and definitions used in this guide:

CEV	Province of BC's Clean Energy Vehicle program
DC fast charging	Direct current fast charging station (or Level 3)
EV	Electric vehicle
EVSE	Electric vehicle support equipment; often the term "charging equipment" is used instead.
Level 1	120 volt outlet charging, similar to standard residential outlet
Level 2	240 volt outlet charging, similar to residential dryer plug
Level 3	Direct current (DC) fast charging, 450 volt
PHEV	Plug-in hybrid electrical vehicle

1. Introduction

Interest in electric vehicle (EV) ownership is growing. A Canadian Automobile Association survey found that 42% of its members would consider some kind of electric vehicle the next time they buy a car.[1] The number of B.C. EVs could increase from approximately 10,000 in 2017 to over half a million in 2031 to over a million in 2041 — one of the highest electric vehicle adoption rates in North America.[2]

In November, 2011 the Province of BC announced new program funding of $14.3 million for a new Clean Energy Vehicle Program (CEV) to provide British Columbians with more affordable clean energy transportation solutions. The program included funding (available until March 31, 2013) for:

- Point-of-sale incentives - up to $5,000 per eligible clean energy vehicle for B.C. residents, businesses, non-profit organisations, and local government organisations. Total funding available was expected to meet short term demand for clean energy vehicles in BC (approximately 1,370 vehicles).
- Residential rebates for electric vehicle charging equipment - rebates of up to $500 per eligible electric vehicle charging station for B.C. residents who own or lease a battery electric or plug in hybrid electric vehicle that is eligible for the point-of-sale vehicle incentives.
- Plug-in BC Community Charging Infrastructure Deployment Fund –targeted the deployment of up to 570 Level 2 EV charging stations for communities, businesses and institutions across B.C.

This funding support for clean energy vehicles and charging infrastructure has stimulated the installation of a network of Level 2 charging stations throughout BC. Planning for this EV charging infrastructure was achieved in a variety of ways and delivered by a number of organizations.

This document is designed for communities who need assistance in designing and implementing a charging infrastructure planning process. The information presented in the guide synthesizes what was learned throughout the planning processes undertaken throughout the CEV program and highlights best practices in community and regional charging infrastructure planning.

2. Understanding EVs and EV Charging

A battery electric vehicle, such as the Nissan Leaf, gets all of its power from a battery. A plug-in hybrid vehicle, such as the Chevy Volt, is powered by a battery until the charge is depleted, then a gasoline engine takes over. In general, the EVs introduced in B.C. in 2011 can drive up to 160 kilometres on battery power alone. About 95% of all car trips in B.C.'s urban areas are less than 30 kilometres, well within the range for today's electric vehicles. BC's low electricity rates means that operating costs for these vehicles are relatively low. A detailed list of different types of EVs is in Attachment 1.

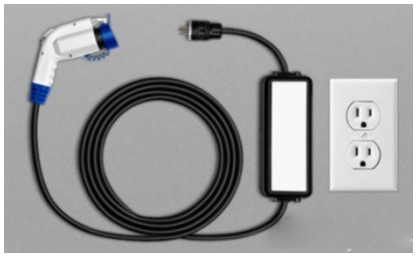
In communities that receive their power from hydroelectricity, EVs reduce light duty vehicle greenhouse gas emissions almost completely. Even if power is provided by fossil fuel fired power plants, studies have

[1] Canadian Automobile Association *Electric Vehicles: What you Need to Know*. http://electricvehicles.caa.ca/

[2] According to BC Hydro's draft Integrated Resource Plan, Appendix 2A – 2011 Electric Load Forecast. https://www.bchydro.com/energy-in-bc/meeting_demand_growth/irp/document_centre/reports/draft_irp.html#app2

shown that EVs use these fuels more efficiently than typical combustion engine vehicles. [3] The key to expanding the purchase and use of electric vehicles is to ensure that the public has confidence in their ability to charge their EV when needed. Reducing range anxiety, promoting EV ownership and normalizing EV use are the main drivers for development of comprehensive local, regional and provincial EV charging networks.

About 80% of EV charging will occur at home through either a 110V outlet (Level 1) or 220V (Level 2) charger. EV owners who can't charge at home are able to charge at work or at a public station if infrastructure is available. In general, charging an EV requires an electrical outlet and some kind of charging equipment.



Level 1 Charging Equipment

Level 1 (110 volt) charging uses a standard household electrical outlet and a special extension cord that acts as the charging equipment. Cars will need 10-20 hours to charge. Most electric vehicles come with a portable 110-volt cord that will work with any standard home outlet within reach.

Residential Level 2 Charging Equipment

Level 2 (220 volt) charging equipment must be hardwired. Cars will take 4-8 hours to reach a full charge. Commercial Level 2 charging equipment (with payment mechanisms and/or network capability) costs between $3,500 and $6,000 for a single cord station[4] (not including installation costs). Outdoor installations require outdoor-rated charging equipment. Wall mount, residential Level 2 charging equipment, which uses the same type of plug as a household dryer, costs around $1,000. Level 2 charging equipment is most relevant to planning for community or regional level charging infrastructure.

Commercial Level 2 Charging Equipment

Level 3 charging or "fast charging" is for commercial and public applications and operates similar to a commercial gasoline service station. Typically, Level 3 charging provides a 50% recharge in 10 to 15 minutes.

[3] *Debunking the Myth of EVs and Smokestacks*, by Chip Gribben, Electric Vehicle Association of Greater Washington, D.C. (EVA/DC). http://evadc.org/wp-content/uploads/2012/07/pwrplnt.pdf

[4] Cost for a one cord charging station based upon 2012 figures. Lower cost stations generally don't have networking capability, which allows users to locate and reserve stations and notifies them when the car is charged. Dual cord stations cost more.

Photo credits: Level 1 & 2 Charging Equipment. Mitsubishi http://www.mitsubishi-motors.ca/media/images/features/imiev-features2.jpg. Commercial Level 3 Charging Equipment: Community Energy Association

Table 1: PEV Charging Levels/Locations

Level	% of EVSE	Circuit	Charging	Cost Range	Time to fully charge	Use
Level 1	54%	120v 20amp	1.4kW-1.9kW	$1,000 or less	12-20 hrs.	Level 1 will primarily be used by EV owners charging at home but commercial and public charging stations can also be Level 1. Most electric vehicles come with a portable 110-volt charger that will work with any standard home outlet. These chargers can also be purchased if necessary.
Level 2	43%	240v 40amp	7.7kW	$2,000 - $10,000[5]	4-6 hrs.	Most community based charging stations and some business and home stations will be Level 2.
Level 3 - DC Fast Charging	3%	450V DC 200Amp	62.5kW DC	$60,000 - $100,000	Under 30 mins. 50% in 10-15 mins.	Commuters, long trip travellers

Wise installation of public charging locations extends EV range and reduces "range anxiety." Public charging may employ a mix of Level 1 and Level 2 charging stations. Opportunities to install Level 3 charging should also be kept in mind, although these types of stations are more expensive to purchase *and* install and are less common.

As of January, 2013, British Columbia businesses, residents and local governments have accessed grants and rebates supporting the installation of 562 public Level 2 charging stations, 90 residential Level 2 charging stations, 355 clean energy vehicles and 13 DC fast-charging stations.

3. Planning for EV Charging Infrastructure

There are four main steps involved in planning for a network of EV charging infrastructure in your community.

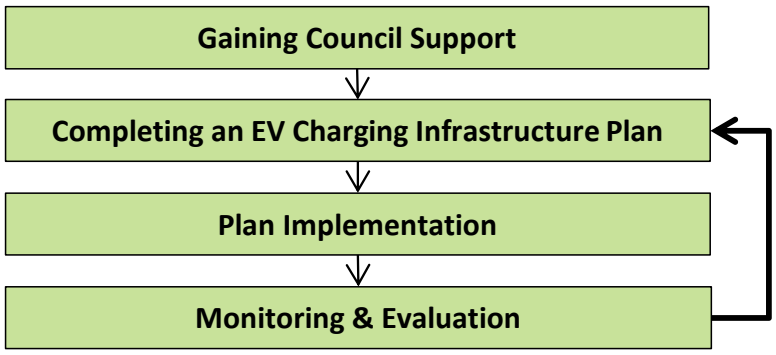


Figure 1: Charging infrastructure Planning Process

[5] Average cost for installation of a Level 2 charger is around $2,500 according to BIG Green Island Transportation (www.BIGGreenIsland.com). To cost $10,000, an installation would require trenching through concrete or asphalt.

a) Gaining Council Support

Gaining Council (or Regional Board) support for exploring the role of EVs in your community is an essential first step. Staff should communicate with Council (or other governing body) regularly throughout the process. Techniques for keeping Council up to date include:

- Council/board workshops
- Regular updates via Council and/or committee reports
- Council/board bulletins
- Encouraging political participation on stakeholder committees
- Invitations to open houses

Some key questions about EV charging infrastructure are discussed below.

How does planning for EVs fit within overall transportation demand management planning?

Supporting EV deployment by creating charging infrastructure is one of four transportation elements aimed at reducing greenhouse gases and air pollution from vehicle combustion of fossil fuels.

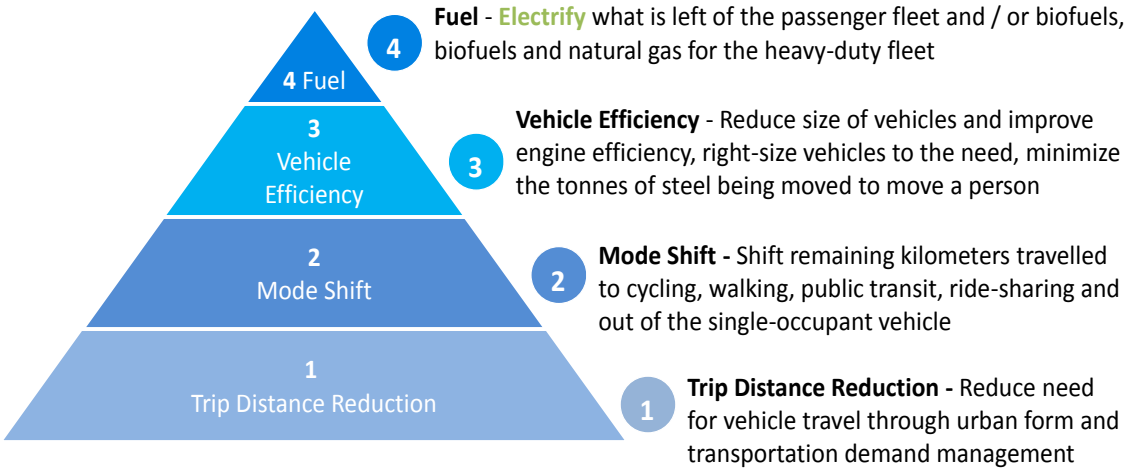


Figure 2: EV Role in Transportation Planning

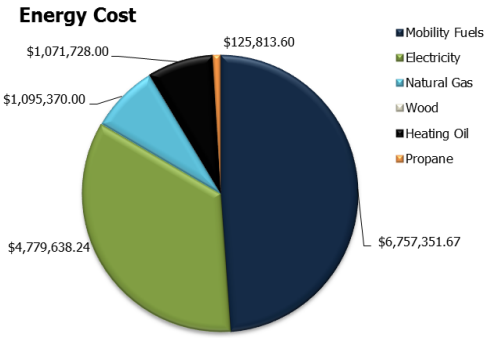
What are the environmental and climate action benefits of EVs?

Increased deployment of EVs in your community can provide several environmental and climate action benefits, including:

- 100% reduction in volatile organic compounds and carbon monoxide emissions
- Almost 100% reduction in carbon emissions in areas powered by hydroelectricity
- 75% reduction in sulfur oxide emissions
- 65% reduction in nitrous oxide emissions
- 31% reduction particulate matter emissions

A community energy and emissions inventory[6] and modelling tools[7] can help identify your transportation-related emissions and costs. The following information was compiled for a City of Duncan EV charging infrastructure planning exercise.

Mobility fuels (gasoline and diesel) are just under 50% of total energy spending at $6.7 million community-wide



Mobility fuels account for most of the GHG's in Duncan community-wide not including industry

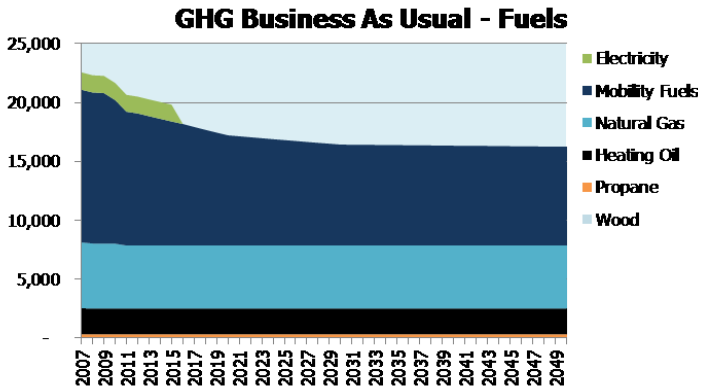


Figure 3: Community Energy and Emissions Inventory

In addition to environmental benefits, what other benefits can EV infrastructure bring to a community?

While most of the benefits of EVs are environmental, enhanced deployment of EVs can offer:

- Green branding and green tourism opportunities for BC businesses and communities
- Employee attraction and retention [8]
- Additional user charging and parking fees (once established)
- A stimulus for economic activity and local jobs related to installation of charging infrastructure and servicing of vehicles
- An opportunity to lead by example, by including EVs in corporate fleets

Community Energy Association's *EV Primer* estimated that, by 2020, PEVs in Metro Vancouver could save between $15 and $74 million annually due to personal and commercial fuel cost savings and health benefits arising from reducing air emission.[9]

[6] Either a locally developed inventory or BC's Community Energy & Emissions Inventories http://www.env.gov.bc.ca/cas/mitigation/ceei/reports.html

[7] BC Hydro's CEEP & CEEP QuickStart planning or other models: http://www.env.gov.bc.ca/cas/mitigation/ceei/modelling.html http://www.bchydro.com/powersmart/local_government_district/ps_communities/ceep.html

[8] US Department of Energy, *Plug-in Electric Vehicle Handbook for Public Charging Station Hosts*, April 2012 http://www.afdc.energy.gov/pdfs/51227.pdf

[9] http://www.communityenergy.bc.ca/sites/default/files/Road%20to%20Zero-Metro%20Vancouver%20EV%20Primer%202012-02-09.pdf

Who will use public EV charging infrastructure?

Charging infrastructure deployed today will support "early adopters" by reducing range anxiety and signaling public support. Local stations will likely provide a top-up charge for residents, business owners, commuters and tourists and can provide charging for municipal and private fleets.

How does supporting EV charging infrastructure support other community goals?

By reducing air pollution and greenhouse gas emissions, supporting EV deployment can complement other environmental and economic community goals. Supportive policy can be included in:

- Official Community Plans (particularly in sections with greenhouse gas emission reduction targets)
- Air quality plans
- Transportation plans
- Local economic development strategies
- Strategic plans
- Integrated community sustainability plans
- Community energy and emissions plans
- Corporate energy and emissions plans

What are other, similar communities/businesses doing?

This guide includes two brief case studies for businesses and two for communities. YouTube videos for each case study can be found at http://www.youtube.com/user/BChydro
Additional case studies can be found at: **Plug in BC:** www.e3fleet.com/pluginbc_resources.html

How much will it cost?

Commercial Level 2 charging stations range in cost from around $3,500 (single cord) to $11,000 (dual cord), depending on level of sophistication.[10] Installation costs vary greatly – depending on the number of circuits and units installed, electrical upgrades required and the need for trenching (particularly through concrete). Installation estimates in BC have ranged from $4,000 - $10,000 per unit. Installation costs can be minimized by careful site selection.[11] Installation costs include additional materials and supplies, trades and project management, necessary permits, connection fees, electrical engineering and design and signage.

How can the cost of electricity used for charging be recovered?

In the short term, particularly if having a charging station helps meet other community or business goals, charging station owners will likely choose to provide charging free of cost, since stations are not likely to be heavily used in the early adoption phase and electricity costs in BC are relatively low. [12]

As public acceptance and ownership of EVs grow, more station owners/operators will wish to recover

[10] More sophisticated charging stations have wireless links to websites and charging services, alerting users to available charging stations or when their car is fully charged and advising managers of equipment failure and total usage.
[11] Source: US Department of Energy, Plug-in Electric Vehicle Handbook for Public Charging Station Hosts, April 2012
[12] A typical daily work commute in Metro Vancouver is estimated to cost around $350 per year.

charging costs. Typically, only electric utilities are authorized to sell electricity. Charging station owners/operators are, however, able to charge for use of the parking space. This kind of fee-for-service can help recover equipment, installation, service and maintenance costs. Several options for point of sale purchase exist. These are discussed in more detail in Section 3(c).

Is this a local government responsibility or should another sector be responsible?

Charging equipment can be local government owned but doesn't have to be. Ownership options should be considered during initial consultation with Council or senior staff, then addressed in detail during a planning exercise. Options include:

- Sole public ownership
- Sole private ownership
- A partnership between public entities or a public/private partnership
- Existing or new non-profit organization or cooperative

Angel Restoration paid for the purchase and installation of a charging station but was able to install the charging station in a public right of way after reaching a licensing agreement with the District of North Vancouver.

Public charging stations in particular may have a combination of owners. In a successful EV market penetration model, public ownership of public charging stations may shift to private ownership. Several businesses may join together to promote EV use and may share ownership of charging equipment. Those who choose sole ownership can still contract with a third party company for operation and maintenance. More information on ownership and partnerships is in Section 3(c).

b) Completing a Planning Exercise

The process of identifying charging sites should focus on locations where an EV can be parked between 1 – 3 hours, allowing for an appreciable recharge. Locations where owners can be expected to park this long include restaurants, theaters, shopping malls, governmental facilities, hotels, amusement parks, public parks, sports venues, arts productions, museums, libraries, outlet malls, airports and major retail outlets.

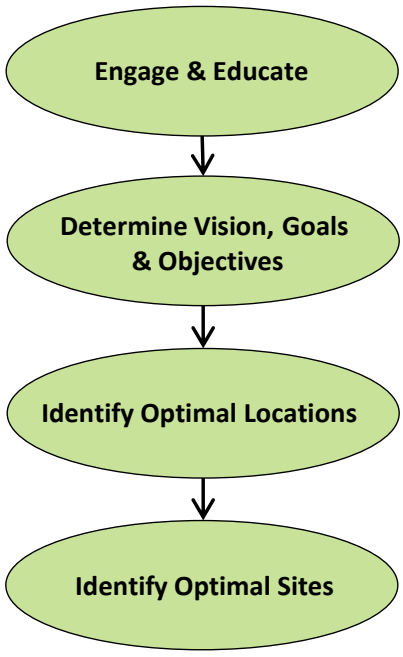


Figure 4: Planning for EV Charging Infrastructure

For smaller communities and regions (population < 20,000), a significant portion of planning can probably be accomplished during a one-day workshop, provided that basic information has been gathered and distributed in advance. Larger communities will likely require a longer process that includes several discussions with stakeholders. Materials to support a planning workshop are provided in Section 6.

In general, an EV charging infrastructure planning process includes four steps. Each of these is described in detail below.

Engagement& education

In the short term, stakeholders, community members and potential partners may benefit from receiving basic information about EVs and EV charging and how these matters relate to broader community goals. Information can be delivered via open houses, participation in community events, or facilitated education sessions and webinars. Consider what might work best for your community. Communities who have gone through the process of locating EV charging stations advise engaging at several points throughout the process. This step may also help identify local champions and possible partners for EV charging station deployment.

Key stakeholders for an EV planning process include:

- Local government Council, staff and standing committee members
- Province of BC
- Community business owners (including vehicle dealerships)
- Local land developers
- Local utility representatives
- Institutions
- Tourism, Chambers of Commerce and economic development representatives
- EV owners
- Public
- Adjoining communities, First Nations and regional districts

EV Workshop in the Peace River Regional District (Photo credit: Pembina Institute)

Developing a vision and goals for EVs in your community

Understanding where EV charging equipment fits within your own community, both in the short and longer term, is helpful. The following questions can be used to guide consideration of the role EVs will play in your community now and in the future:

- How do our goals for EVs mesh with other community goals?
- EV owners will include those who use their car for local trips (commuting to work or running errands) as well as those who are visiting our community or passing through on their way to somewhere else. Do any of these groups have priority over another?
- What are our goals? Are we trying to encourage a high level of local EV ownership? Easy access to charging for all EV owners? Reduced GHG emissions from personal transportation?
- What timeframes are we planning for? What kind of charging equipment deployment is suitable for the short term (1-5 years)? What is our vision for the longer term (5-20 years)?

Sample Vision:

Our public electric vehicle charging infrastructure meets the needs of all residents, businesses and visitors to our community today and will continue to do so in the future.

Some common goals include:

- Reducing greenhouse gas emissions
- Improving local air quality
- Increasing EV visibility and reducing range anxiety
- Creating or enhancing a "green community" image
- Supporting early EV adopters within the community
- Providing a top-up charge to commuters/tourists
- Provide charging for municipal and private fleets
- Supporting local businesses interested in green tourism or in using EVs in their fleets
- Removing any regulatory barriers for EV charging[13]

Policies to include in Official Community Plans should be based upon your vision and goals and be consistent with other, related plans. Policies supporting EV deployment can consider tools requiring or encouraging EV charging infrastructure in residential buildings, businesses and institutions. For example:

City of Vancouver requires charging capacity in all new residential construction and / or new commercial construction.

City of Surrey requires charging infrastructure (or alternative energy choices) in new gas stations.

Reviewing and ranking criteria

Location criteria for charging station are listed below. Reviewing and rating criteria in terms importance, from both a short and longer term perspective, helps clarify your goals. Which criteria are more important to address now and which can be addressed later? This can help you select the best location from several good ones.

For clarification, ***locations*** are broad areas within your community where the presence of a charging station will help meet community goals. An example of a location is the local mall or business district. A ***site*** is the specific position of the charging station within location boundaries. An

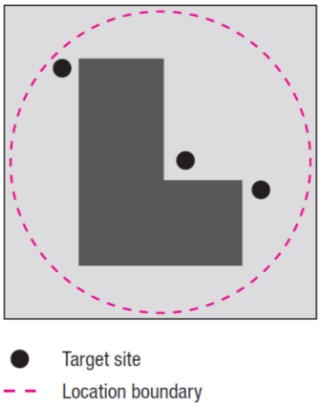


Figure 5: Location vs. Site

[13] Regulatory barriers are often related to parking regulations or guidelines, for example, those that require a certain number of stalls to be consistently available or those that restrict the use of visitor parking.

example of a site is “a parking spot adjacent to the north entrance of the mall, just after the handicapped parking spaces.”

Location Criteria

Charging stations are best located somewhere that:

- Is easy to see and find
- Has something else to do nearby
- Demand for parking isn’t so high that it creates conflicts for parking space
- Supports an even distribution throughout the community
- Supports residential and commercial areas with expected future growth
- May provide co-benefits (local economic development, green branding,)
- Supports commuters, visitors, residents, businesses and/or institutions.

More information and a table for ranking each of these criteria are provided in Section 6.

Identifying optimal locations

The locational criteria above help to identify all potential station locations in your community. In smaller communities, this step may be combined with site level planning. Materials to support this exercise are provided in Section 6.

The University of British Columbia’s Transportation Infrastructure and Public Space Lab[14] has developed a detailed process (below) for identifying and evaluating locations and sites.

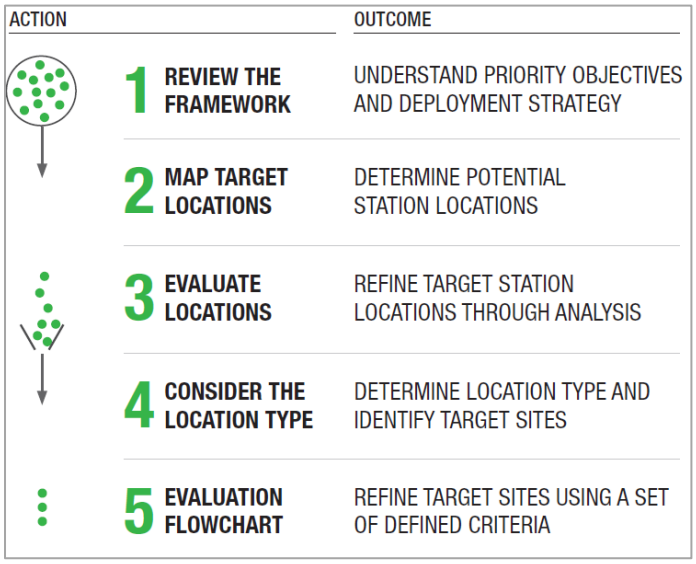


Figure 6: Identifying & Evaluating Locations

A map of the community is essential to this process. An ideal map would show community boundaries and any existing charging stations as well as the features listed in Table 2. For larger communities, it can be helpful to impose a five km grid on the map. Five kilometers is a good guideline for spacing stations in a large urban or regional plan. If aerial photography or satellite imagery is available (via either in-house mapping systems or free, on-line mapping) it can provide a highly effective reference for identifying possible locations.

[14] Transportation, Infrastructure & Public Space Lab: http://www.livesmartbc.ca/incentives/transportation/Level-2-Station-Location-Process.pdf

Table 2: Features to Include on Map

Feature	Description	Goals: Visible & Convenient	Community Destinations	At-home charging
Major and minor roads	Highly visible, well-travelled locations.	✓		
Transportation hubs	Transit exchanges, shared bike areas, train stations, major intersections, park'n'ride locations	✓	✓	
Institutional land uses	City Hall, hospitals, schools, universities, colleges, recreation and community centres and libraries	✓	✓	
Commercial uses	Retail centres, especially large or popular centres such as malls & grocery stores, business districts or tourism destinations	✓	✓	
Gas stations	Sites already popular for "refuelling"	✓		
Parking facilities	Surface lots, underground or structural parking facilities not covered under other uses	✓		
Future growth areas	Especially if significant commercial, institutional or residential (higher density) is planned	✓	✓	✓
Jobs density	Employment centres with a significant number of jobs		✓	
High density residential	Areas where residents might not have their own parking such as apartments & townhouses			✓
Publicly owned properties	Publicly owned facilities not covered under institutional uses such as works yards, etc.		✓	

Site level planning

Table 3 describes the characteristics of good sites for EV charging equipment.

Table 3: Criteria for Charging Infrastructure Sites

Visible	The site chosen should maximize visibility to possible users.
Secure	Should be well lit and visible to others. Using Crime Prevention through Environmental Design principles can assist with design.
Near a source of power	Existing light fixtures, power poles etc. can reduce installation costs by eliminating the need to trench through concrete or pavement and reducing the amount of renovation required to extend electrical conduits.
Level topography	Site should not be on a hill (rolling risk) and not located in a depression that might gather rainwater or snow.
Wide availability	Site should be available, ideally, at any time of day but, at a minimum, during business hours.
Easy access and egress	Above ground locations often have more flexibility. There should be ample room to accommodate the number of vehicles planned for without obstructions.
Sheltered and ventilated	This will greatly improve the charging experience from a safety and comfort perspective.

Site planning involves two stages:

1. Identify possible sites at preferred locations. If more than one possible site is identified, evaluate sites based on the criteria listed in Table 3 (previous page). Figure 7 (from UBC TIPS) suggests possible sites for various locations.

   In smaller communities, this stage can often be completed using maps and personal knowledge of suggested sites. If necessary, take a walk through the location to identify possible sites.

   This is also a good time to clarify ownership of possible sites. Confirming ownership of the parcel of land on which the station will be located is critical to all ownership models, system operation and the development of partnerships.

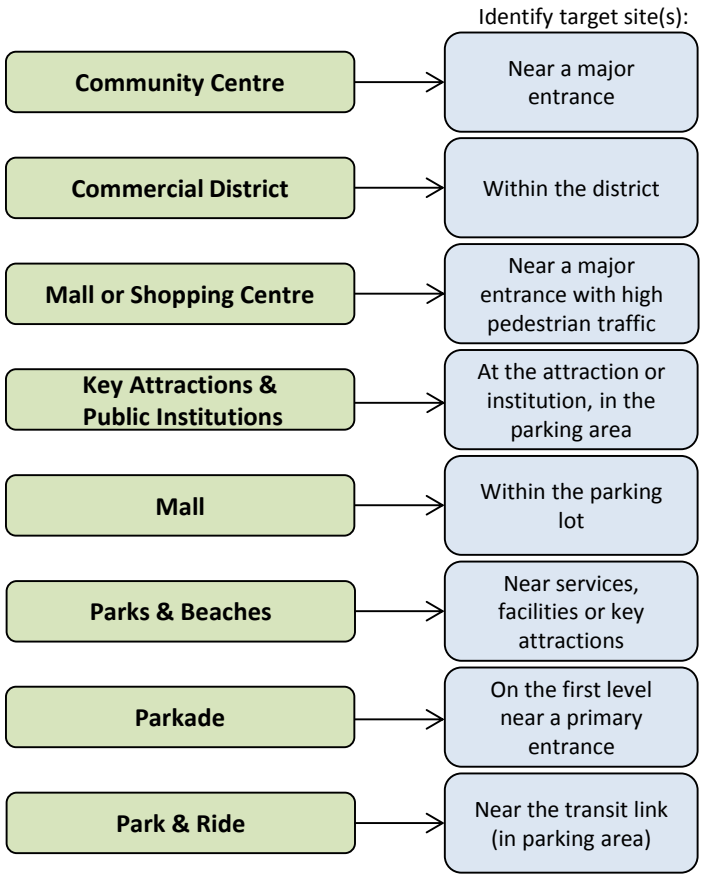


Figure 7: Suggested Sites by Location Type

2. Once the number of possible locations and sites has been reduced to the most promising possibilities, a detailed site evaluation by a qualified installer should be completed and a site plan prepared.

   This plan should include:[15]

   a. Measurement of the potential site to ensure ability to accommodate planned number of vehicles and charging equipment
   b. A review and evaluation of electrical conduits near the site and measurement of their distance from the site
   c. A sketch showing proposed orientation of parking site and location of equipment
   d. An estimate of costs associated with bringing electrical power to the site & other installation costs
   e. Location of the main electrical panel, branch circuits and conduits
   f. Location of hazardous materials (if any)
   g. Location of charging stations
   h. Lighting and lighting
   i. Traffic flow

[15] Pacific Gas & Electric Company: *Electric Vehicle Infrastructure Installation Guide* http://evtransportal.org/evmanual.pdf

j. Ventilation (if necessary)
k. Description and locations of signs
l. Curbing, wheel stops, cut-outs, setbacks, and bumper guards

A detailed site plan can be requested as part of an equipment and installation estimate. A list of qualified service providers can be found at: http://www.e3fleet.com/pluginbc_resources.html

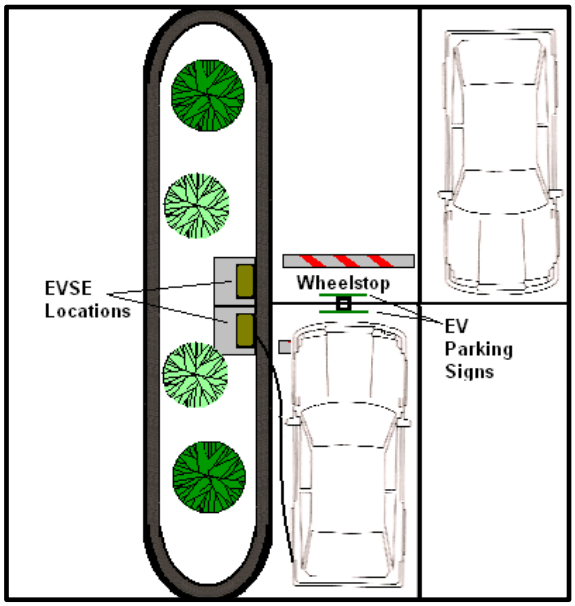


Figure 8: Detailed Site Plan

c) Implementing the Charging Plan

Solidifying partnerships

Determine roles and responsibilities of each partner before purchasing and installing charging equipment. Agreements can be formalized using licenses and contracts. When developing a partnership, consider who will be responsible for:

- Cost of charging equipment
- Installation costs, including permits and inspections
- Maintenance costs (including responding to any vandalism)
- Cost of electricity
- Ownership of the land station will reside upon (if public land but private operation a license is needed)
- Liability insurance
- Parking priorities (space reserved for EVs or not and limits on parking time)
- Signage
- Financial management including point of sale purchasing or other purchasing options

Payment systems

As public acceptance and ownership of EVs grow, more station owners/operators will wish to recover charging costs. Typically, only electric utilities are authorized to sell electricity. Charging station owners/operators are, however, able to charge for use of the parking space. This kind of fee-for-service can help recover equipment, installation, service and maintenance costs. This is where long term planning for charging infrastructure is important. If it is conceivable that you will eventually want to charge for the service, it is best to make sure you purchase charging equipment that provides point of sale functions. Several alternatives for point of sale purchase exist.

Card Readers

Several types of card readers may be incorporated into EV charging equipment. Credit/debit card readers are simple to use and are already widely accepted by the public. The credit/debit card records a fee each time the public charging equipment is accessed. Like charges for parking, this fee is based upon access to the parking space rather than how much electricity is used.

A smartcard is a card that is imbedded with a microprocessor or memory chip. A smartcard can be sold as a monthly subscription and imbedded with user information. Information captured in each transaction can be used to capture data about charging station use. A smartcard can be pre-paid to allow for a pre-set number of charge opportunities or an account can be set up to bill a credit card for each use.

In both cases, a communication system from the reader to a terminal for off-site approval and data recording will be required. Approval received may then close a contact for power to be supplied to the EVSE. The cost of this system and its integration into the EVSE will be a design consideration.

Typical parking fee recovery methods

Costs can be recovered using the same strategies that are used for non-EVs. Coin operated parking meters, central kiosks in public pay parking lots or pay by phone can all work for EV parking.

RFID Subscription Service

RFID refers to radio-frequency identification devices - small electronic devices with a chip and antenna. Like a smartcard, an RFID fob can be programmed with user information. The RFID reader collects information from the fob to activate the EVSE station. A monthly user subscription keeps the fob active and the monthly fee can be based either upon the number of actual uses or a set fee. The charging station reader is programmed to accept the RFID.

Purchase and installation of equipment

Choosing which EV charging equipment to purchase at any point in time should balance initial cost with projected longevity of the equipment and long term value. While you may choose to not collect revenue from charging stations in the short term, equipment that uses software to track use and charge customers may be helpful in the future. Steps for purchasing and installing charging infrastructure are outlined below and illustrated in Figure 9.

1. Request quotations for equipment purchase and installation. A list of approved equipment, suppliers and installers is available at: www.e3fleet.com/pluginbc_resources.html
2. EV owners and corporate fleet operators should consult with the EV supplier to determine whether ventilation will be required and what equipment to purchase.
3. Consult with your electric utility to determine rate structure and any requirements for a special or second meter.
4. Consult with a licensed electrical contractor to assess electrical capacity and plan installation including:
    a. location of equipment,
    b. routing of the electrical wiring conduit from the nearest utility service panel ,
    c. capacity of the utility service panel, ensuring it is adequate to meet Level 1 or Level 2 charging requirements,
    d. ventilation requirements, and
    e. adequacy of current utility service.
5. Obtain an installation quote.

6. Submit required permitting documents and plans.
7. Arrange for installation and utility service components, if required.
8. Have final installation inspected.

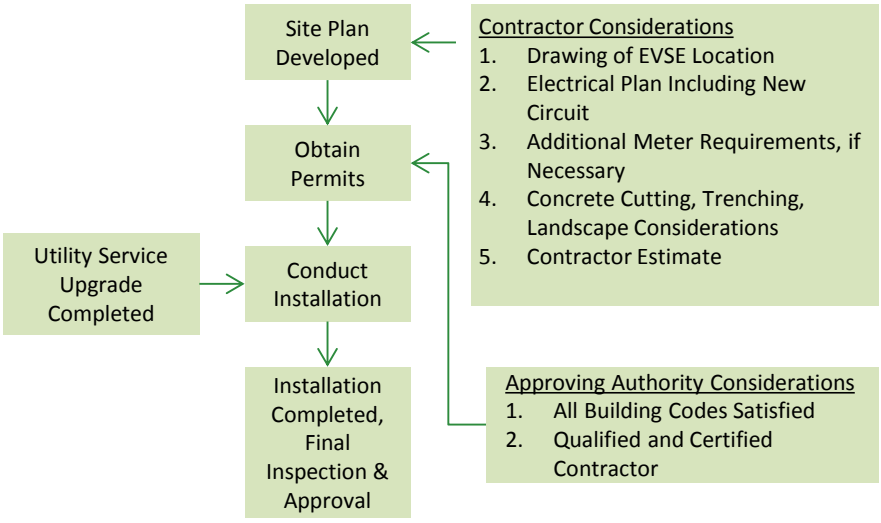


Figure 9: Installation Process

Signage

In addition to the signs and warnings required by the Canadian Electrical Code, information signage is recommended for public and commercial access charging stations. The BC Ministry of Transportation and Infrastructure has developed an *Electric Vehicle Signage Package*, which includes both way-finding signage and signage to be installed at the parking stall where an EV charging station will be installed. Detailed information can be found at:

Mandatory and Optional Signage Requirements for CCI Fund
Complete Electric Vehicle Signage Package
Package of Signage AI Graphics (ZIP file)
Sign Suppliers[16]
Pavement Marking Template (with Green Background)
Pavement Marking Template (Symbol only - white on pavement)

Lighting and shelter

Lighting provides safety and convenience. Lighting should be bright enough to easily read associated signs, instructions and charging equipment messages and provide a sense of security to the user. Lighting should extend around the vehicle to allow for all possible EV plug-in locations.

Shelter is not typically required for out-door rated equipment. For locations with significant rainfall or snow, sheltering charging equipment can provide added incentive to potential EV users. Locations within parking garages or private garages that are well protected from the environment may use charging equipment that is not specifically outdoor rated.

[16] It is not mandatory to use a sign supplier from this list. This list has been provided by the Province to assist with finding a sign supplier.

Persons with disabilities must have access to all areas around the charging station and their EV. Whether indoor or outdoor, this means that the charging station cord (also known as the EV coupler) should be located at a height of not more than 1.2 m (4 ft) and not less than 600 mm (24 in.) above the parking surface. [17] An accessible parking stall is 3.7m (9-foot) wide by 7.4m (18-foot) deep which includes an access aisle of 1.2 m (5 feet) on the passenger side. A van accessible space is the same size with a 2.2 m (8 foot) access aisle on the passenger side. The placement of the charging infrastructure must allow adequate space for a wheelchair to pass the wheel stop.

Promotion

Make sure that residents, businesses and visitors know about the charging stations in your community. You can get the word out via:

- Press releases
- Articles in local newspapers
- Information available at local events.
- Post locations to PlugShare (www.plugshare.com/) and local websites.
- Information at City Hall and at public venues
- Adequate signage
- Maps of charging locations included in official plans such as Official Community Plans and transportation plans.

Operating and maintaining equipment

Charging equipment generally does not require routine maintenance. However, periodic inspections should be conducted to ensure that the equipment remains in good working order. Cleaning may be required depending upon local conditions. Testing of communications systems and lighting should be conducted periodically. Repair of accidental damage or vandalism may also be required. Unless otherwise agreed, these responsibilities generally fall to the station owner.

Providing a means to report problems is important. Each public charging area should be equipped with a method whereby an EV user can notify equipment owners of trouble found. Stations that are out of service or not kept in an appealing condition will have a negative impact on public and user perception.

d) Monitoring Use and Re-evaluating Demand

More than simply recording payment for service, the use of a smartcard or RFID[18] can substantially increase the amount of information available about usage of a public charging station. Being able to capture this information helps charging station owners determine which stations are frequently used and which are not, helping to monitor success of equipment installations and plan for the future. Time of day usage data may show peak usage at unexpected times, providing helpful information to utilities. Not all charging stations available for purchase provide options for payment and data collection. If this is the case, a utility sub-meter can be purchased and installed to track usage.

[17] Source: www.bchydro.com/about/sustainability/climate_action/plugin_vehicles/charging___infrastructure.html
[18] Radio-frequency identification device.

4. Lessons Learned

Pembina Institute interviewed staff from five municipalities in Washington and Oregon to provide insights into successes and challenges in planning and installing EV charging stations[19]. The following techniques helped support success in these five communities:

- Including EVs in local government sustainability and transportation plans and projects
- Internal collaboration
- Municipal levers, such as expediting installation permitting and code changes
- Federal and state government support
- Working with other public sector entities in a regional approach
- Information sharing and public outreach through multiple sources

For more information, visit http://www.pembina.org/pub/2375

[19] *Backgrounder: Electric Vehicle Charging Stations: Lessons learned from municipalities in Washington and Oregon*, T. Shah, K. Laufenberg & E. Pond http://www.pembina.org/pub/2375

5. Case Studies

a) Kicking Horse Coffee & Groundswell Network Society

Kicking Horse Coffee is located in the District of Invermere in BC's Columbia Valley. Kicking Horse Coffee, the number one selling organic fair trade coffee in Canada for over a decade, has recently expanded to provide a café at their roasting plant. Kicking Horse Coffee employs about 40 people and is one of the most recognizable businesses in the Columbia Valley.

While Invermere has a permanent population of around 4,000, as a popular tourist destination for both BC residents and Albertans, its population can reach nearly 40,000 on summer weekends.

Groundswell Network Society promotes sustainability in the Columbia Valley by fostering innovative projects that encourage health – for people, the environment and the economy**.**

Why did you decide to install an EV charging station? In 2012, the company was approached by Bill Swan from Groundswell about a possible 50/50 partnership to install a Level 2 EV charging station at the Kicking Horse Cafe. Having an EV charging station on site fits with Kicking Horse's green ethos and other green energy initiatives at the company, including wind power and solar hot water.

How did you go about selecting a site or sites? Site selection for the one charging station to be installed was pretty simple – a spot was identified right at the Café amongst other parking.

What challenges did you face? Challenges were minimal. The station was installed in early March, although signage still needs to be installed, both on-site and on the highway.

What advice would you give to other businesses/communities? The partnership with Groundswell was very helpful. Groundswell took ownership of the project and handled all paperwork and funding applications.

b) Fairmont Hotels and Resorts

Fairmont Hotels & Resorts is committed to environmental protection and sustainability across all 50 locations worldwide. Fairmont is guided by their 'Green Partnership Program' – a stewardship program that strives to minimize environmental impact through conservation best practices such as waste management, sustainability and energy and water conservation. Fairmont has partnered with the World Wildlife Fund (WWF) to develop a Climate Change Strategy, which includes the development of a corporate-wide target to reduce GHG emissions to 20% below 2006 levels by 2013. Fairmont is a supporter of WWF's sustainable transportation and electric vehicle (EV) initiative and has also developed an energy and carbon management program.

Why did you decide to install an EV charging station?
In 2012, Fairmont Hotels & Resorts became an official supporter of WWF's EV initiative, which spurred broad hotel support and motivated Fairmont to create further EV opportunities with other partners and in other program areas. In British Columbia, Fairmont has installed charging stations at four out of five hotel properties and is proposing a station at the 5th. Installation of charging stations at Fairmont properties reflects the company's commitment to sustainability while supporting Provincial initiatives and potential customers who are switching to electric vehicles. Installing charging stations encourages guests to travel green and reduce their carbon footprint. Contributing to the broader network of electric vehicle charging stations will help to expand EV use and promote a cleaner environment.

How did you go about selecting a site or sites? For most BC Fairmont properties, charging stations are located inside the parking garage and are available to guests of the hotel, restaurant and spas. At the Fairmont Waterfront property, the charging station is located on the driveway in front of the hotel where it is visible to the public. The location of this charging station allows doormen to help EV drivers connect to the charging station if necessary.

What challenges did you face? Installing charging stations did not pose significant challenges. Once suppliers are identified, and the right equipment specified, installation is a seamless process. Training the engineering and maintenance teams at the hotels was also relatively simple.

What advice would you give to other businesses/communities? Find the right spot to locate the station – it should be in a place where it doesn't hinder daily operations. Take care selecting the right charging station provider and ensure that the amperage available is enough to charge a vehicle in three to four hours (Level 2), so that a parking spot is not occupied for too long. Research and polling can help understand how many clients drive an electric vehicle and what barriers discourage people from switching to EVs. Fairmont encourages businesses to embrace electric vehicles and help set Canadian standards for implementing clean, green energy practices.

c) City of Campbell River

The City of Campbell River , which has a population of about 32,000, is located on the east coast of Vancouver Island. Campbell River has been a leader in sustainability initiatives for several years. In 2008, Council adopted the *Green City Strategy* and, in 2009, the City's Sustainability Department was formed to help integrate sustainability across all municipal departments and operations. The 2012 *Sustainable Official Community Plan* was built upon strong community engagement and, through that process, community support for broader sustainability initiatives emerged as a community priority.

Why did you decide to install EV charging stations? The development of a *Community Energy and Emissions Plan* and *Master Transportation Plan* identified an opportunity to reduce community GHG emissions by supporting EV charging infrastructure. The City wished to provide this infrastructure to support alternative transportation for both residents and visitors. Acknowledging that a network of charging stations is required to expand EV use, the City also felt that the Province's EV charging station funding initiative was an excellent way to develop a provincial network.

How did you go about selecting sites? A stakeholder workshop was held with local car dealerships, North Island College, School District 72, Vancouver Island Health Authority, environmental organizations, the Regional District and local property owners to identify emerging needs and trends around EVs. Initially, the City had applied for funding for ten charging stations but, through the planning and workshop stages, several businesses and institutions came forward with strong interest in hosting a charging station. As a result, two charging units are being installed at each of six locations, for a total of 12 EV charging stations. Three locations are on City-owned property – City Hall, the Visitor Info Centre and Dogwood Operations Centre. Two stations are located at North Island College and four are at the Discovery Harbour Shopping Centre.

What challenges did you face? Tight timelines were initially an issue. Completing a planning process and stakeholder engagement to confirm 12 charging station locations took a significant amount of effort. Developing a Request for Proposals with language consistent across different suppliers was a challenge because suppliers offer different types of charging station equipment or describe the same feature using different wording. In many case, the challenge for smaller remote communities is that dealerships are not yet equipped to service electric vehicles.

What advice would you give to other businesses/communities? Complete a comprehensive planning process, particularly if you intend on installing multiple stations. Engaging with the community and local businesses and organizations is key to identifying the most practical locations for charging stations. Do not underestimate the costs associated with the project. Provincial funding made the project viable, but the time and human resources required to move the initiative forward was significant. Communication internally and community-wide is critical. A dedicated coordinator or point person for the project is a necessity, not only to handle communication but to facilitate cross-department collaboration. Learn from other communities by asking for sample RFPs and other related materials.

d) City of Rossland

Rossland is located between the Monashee and Selkirk mountain ranges in the West Kootenay region of BC and has a population of just over 3,500. Rossland has been active in sustainability initiatives for years; a priority that was formalized in 2007 with the development of a Strategic Sustainability Plan. This Plan identified energy efficiency and emission reduction as priorities for a sustainable community. Although electric vehicles were not an explicit component of the Plan, an opportunity to pursue funding for such an initiative complements the policy direction around energy and emissions. In 2009, a citizen-led Sustainability Commission was established to assist in the implementation of the Sustainability Plan.

Why did you decide to install an EV charging station? When Provincial grants became available to local governments, the Sustainability Commission felt that it was a great opportunity to facilitate the development of EV technology in the community. Given the distance of Rossland from larger municipalities in the Lower Mainland, installing a charging station may encourage drivers of electric vehicles to visit Rossland. The charging stations provide another attraction to the community and, on a broader scale, helps to establish a province-wide network of charging stations, which will hopefully lead to the broader uptake of electric vehicles.

How did you go about selecting a site or sites? Site selection was a relatively simple step in the process. The Sustainability Commission wanted to install charging stations close to downtown to enable accessibility to local shops and restaurants. Placing the charging stations downtown will help to promote local economic development. The specific parking area that was chosen was being re-paved, so the timing was ideal to make the changes necessary to the sites where the charging stations will be installed.

What challenges did you face? Lack of knowledge about EV charging stations meant that there was a significant learning curve for staff to identify the best supplier. With limited expertise and knowledge, it was a significant challenge to evaluate service quotes put forward by suppliers. Timelines for the project were a challenge because stations were initially required to be installed by March. In Rossland, there is still significant snow cover in March, so receiving an extension to install charging equipment in May has made installation more feasible. It was relatively easy to move from the initial idea to approval for the project; however implementation has required a significant amount of staff time and resources.

What advice would you give to other businesses/communities?
Look for external support and guidance around technology to understand what will work best in different communities.

6. Materials to Support EV Charging Infrastructure Planning

A. Support Materials for Planning Workshop

1. List of stakeholders
2. Agenda
3. Location and site exercise
4. Location criteria rating sheet
5. Rating sheet for proposed locations
6. Rating sheet for preferred sites
7. A map or maps showing:
    - Community boundaries
    - Existing EV charging stations
    - Major and minor roads
    - Transportation hubs
    - Institutional land uses
    - Commercial uses
    - Gas stations
    - Parking facilities
    - Future growth areas
    - Jobs density
    - High density residential
    - Publicly owned properties
    - Aerial photograph or satellite imagery
    - A five kilometre grid for larger community or regional planning
8. Presentation material

B. Stakeholders for Consultation

Key stakeholders for an EV planning process include:

- Local government staff and Council and committee members
- Province of BC
- Community business owners, including vehicle dealerships
- Local land developers
- Local utility representatives
- Institutions
- Tourism, chambers of commerce and economic development representatives
- EV owners
- General public
- Adjoining communities and regional districts

C. Workshop Agenda Template

- Welcome and introductions (15-30 mins)
- Learning from others (30-60 mins)
- Provincial and utility perspectives (30 mins)
- Opportunities and challenges (30 minutes)
- Plan vision and goals (30 mins)
- Review location criteria (15-30 mins)
- Review, roles and responsibilities -local government, residents, businesses and institutions (30 mins)
- Charging station location exercise (60-90 mins)
- Rating and ranking of proposed locations against criteria, vision and goals (30-60 mins)
- Identification of possible sites for top rated locations (30-60 mins)
- Summary and next steps (15 mins)

D. Location and site criteria worksheet

Electric Vehicle Charging Station Planning
Charging Station Location Exercise

Please take an hour or so to consider possible charging station locations within or near the boundary of the [your city]. The goal of the project is to identify 8-10 possible charging station locations for detailed technical evaluation. Please use the table on the next page to note your thoughts on possible locations, their role within the community (Community Level Criteria) and what you know about the site (Site Level Criteria). Site level criteria columns do not need to be 100% complete, however, please fill in as many as you can. If you wish to complete more than one table, please feel free to print additional pages.

If you are able, transfer the information back into this Word document and email it to me **by [time, date]** Some examples of community level criteria are listed in the table below:

Community Level Criteria	Examples
Community Centres/Destinations	Community centres, key attractions and public institutions such as education, health, sports centres and fields, community and recreation centers, libraries, parks, museums, beaches.
Major Employment Centres	Office parks, major employers, industrial centres, clusters of service (not retail) oriented businesses.
Major Retail Centres	Commercial district, mall or shopping centre with services such as retail, service, dining, etc.
Highly Visible/Well Travelled Locations	Major intersections and roads, gas stations, parkades, park and ride locations.
High Density Residential	Clusters of town homes and apartments
Future Growth Areas	Areas planned for higher density residential, retail or mixed use

	Community Criteria						Site Level Criteria							
Possible Site / Address	**Community Centres / Destination**	**Major Employment Centre**	**Major Retail Centre**	**Highly Visible (Intersection/Maj or Road, ParknRide)**	**High Density Residential**	**Future Growth Area**	**Site publicly owned?**	**Source of power nearby?**	**Site is secure: well lit and visible**	**Not on hill?**	**Available 24 hours?**	**Above ground?**	**Easy access and egress?**	**Sheltered, well lit and ventilated?**
Example: Library	*yes*	*no*	*no*	*no*	*no*	*no*	*yes*	*maybe*	*mostly*	*yes*	*yes*	*yes*	*yes*	*mostly*

E. Rating/ranking sheet of locational criteria (from perspective of local goals)

Please rate each of the location criteria below for the short term and long term development of EV charging stations in Duncan. Assign ratings as follows:

Very important = 3
Important = 2
Less important = 1

Criteria:	**Rating – Short Term (March 2013)**	**Rating – Long Term (to 2020)**
Easy to see and find		
Something else to do nearby		
Supporting:		
Commuters		
Visitors		
Residents		
Businesses		
Institutions		
Co- benefits:		
Local economic development		
Green branding		
Other		
Avoidance of conflicts for parking		
Even distribution throughout community		
Emphasis on future growth areas		

F. Rating of Possible Locations

Location No.	Possible Location / Address	Location Rating: Very Promising = 3 Promising = 2 Less Promising = 1
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

G. Rating Sheet for Proposed Sites

Location No.	Possible Site	Site Rating: Very Promising = 3 Promising = 2 Less Promising = 1

7. More Information

The following organizations and websites can provide more information about EVs and EV charging:

- **BC Hydro:** www.bchydro.com/about/sustainability/climate_action/plugin_vehicles/charging___infrastructure.html
- **BC Climate Action Toolkit:** http://www.toolkit.bc.ca/
- **Community Energy Association:** www.communityenergy.bc.ca/
- **Pembina Institute:** www.pembina.org/transportation/electric-vehicles
- **Plug in BC:** www.e3fleet.com/pluginbc_resources.html
- **UBC TIPS lab:** www.tipslabubc.com/

Attachment 1: Types of Electric Vehicles

Type	Description	Example
Plug-in Hybrid Electric Vehicle (PHEV)	PHEVs have the ability to travel for some distance in charge depleting (CD) mode using electrical energy from the grid. These vehicles also have an on-board fossil fuel engine which acts a generator for the electric motors in Charge Sustaining (CS) mode. The engine is also sometimes called a 'range extender'. This class of vehicle automatically engages the engine when the battery charge becomes low.	Chevrolet Volt
Battery Electric Vehicle (BEV)	BEVs are fully electric with no fossil fuel engine. Energy is received from the electrical grid and stored in a battery. Range on these vehicles can be limited due to battery capacity and weight.	Mitsubishi MiEV
Light Electric Vehicles (LEV)	A Light Electric Vehicle LEV is a land vehicle propelled by an electric motor that uses an energy storage device such as a battery or fuel cell, has two or three wheels and typically weighs less than 100kg.	Scooters, electric bicycles & Segways
Hybrid Electric Vehicles (HEV)	HEVs were first introduced to Metro Vancouver streets in 2000 and now number over 12,000. These vehicles do not receive energy from the electrical grid. Energy from an on-board gasoline engine is stored in a battery. Both an electrical motor and gasoline engine are used to move the vehicle.	Toyota Prius Honda Insight
Limited Speed Vehicle (LSV)	A LSV is a fully electric vehicle typically manufactured in low volumes and not crash-tested and is therefore limited to low speed roads (usually less than 50 km/hour).	Might-E truck Dynasty Corporation vehicles (defunct)
Fuel Cell Vehicles	A Fuel cell vehicle or Fuel Cell Electric Vehicle (FCEV) is a type of hydrogen vehicle which uses a fuel cell to produce electricity, powering its on-board electric motor. Fuel cells in vehicles create electricity to power an electric motor using hydrogen and oxygen from the air.	BC Transit's fuel cell buses.

Attachment 2: Regulatory Agencies

The *Local Government* Act is the primary legislation for regional districts and improvement districts, setting out the framework for governance and structure, as well as the main powers and responsibilities. The Act covers important authorities for both municipalities and regional districts, such as statutory requirements for elections and planning and land use powers. The Act also includes key provincial powers such as authority for the BC Building Code and the office of the Inspector of Municipalities.

The **Building and Safety Policy Branch (Ministry of Housing and Social Development)** is responsible for developing and implementing a modern legislative framework for regulating safety in the design, construction and occupancy of buildings. Central to this requirement are the British Columbia Building Code and British Columbia Fire Code. The 2006 BC Building Code came into effect on December 15, 2006. The Building and Safety Policy Branch also manages agreements with eight local governments to administer electrical safety programs within their own jurisdiction. Like the BC Safety Authority, these local governments were delegated this authority under the *Safety Standards Act*, effective April 1, 2004.

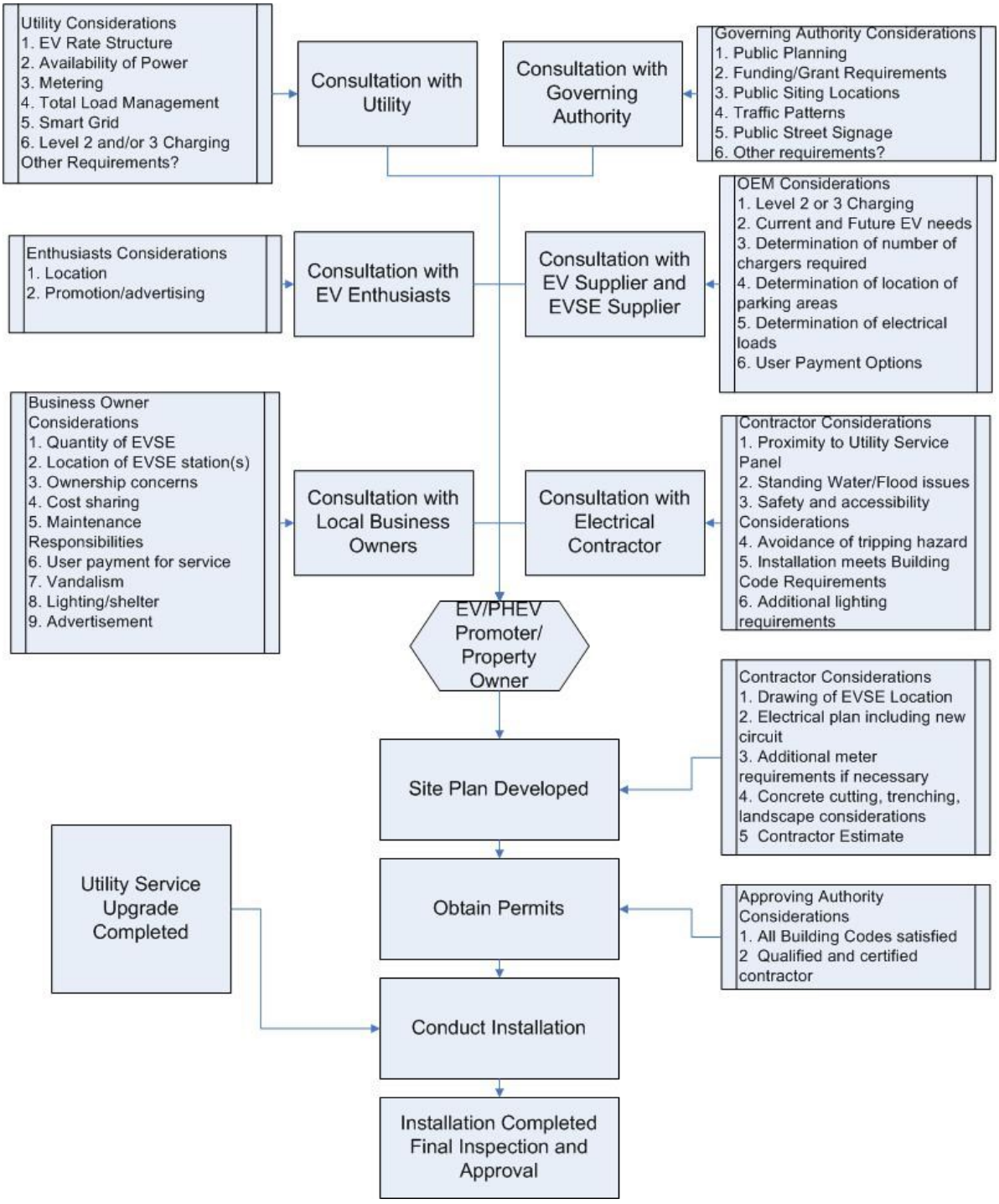
Administration of safety services has been delegated in part to the **BC Safety Authority (BCSA)** which is an independent, self-funded corporation that inspires safety excellence in British Columbia by partnering with business, industry, institutions and the general public to enhance the safety of technical systems, products, equipment and work. The BCSA licenses residential, industrial and commercial electrical contractors to perform electrical work and maintains records on these licensed contractors. An electrical contractor is required to name a qualified Field Safety Representative. BCSA is responsible for certifying FSRs. Electricians performing installation of EVSE must be qualified and any permits required by the authority having jurisdiction must be in place.

In BC, the **Canadian Electrical Code (CEC**) is adopted with variations, as the BC Electrical Code under the *Safety Standards Act* and administered by the BC Safety Authority. The CEC is a standard published by the Canadian Standards Association (CSA) for addressing the installation and maintenance of electrical equipment. It is prepared and revised by experts and stakeholders representing all interested groups. Eight local governments administer their own electrical safety program and administer this Code. The current CEC standard addressing safety standards for electrical installation is C22.1-09 (Part I). The current CEC standard addressing off-board charging system equipment for recharging Electric Vehicles is C22.2 No. 107.01 Section 17. British Columbia's adoption of this standard is pending.

Established as a Crown Corporation under the authority of the *Homeowner Protection Act* the **Homeowners Protection Office** is responsible for licensing residential builders and building envelope renovators province-wide, administering owner builder authorizations, monitoring the performance of the third-party home warranty insurance system underwritten by the private sector and administering financial assistance programs for owners of water-damaged homes.

The *Engineers and Geoscientists Act* of British Columbia is administered by the **Association of Professional Engineers and Geoscientists of British Columbia** (APEGBC). The primary duty of the Association is to uphold and protect the public interest respecting the practice of professional engineering and the practice of professional geoscience. In meeting its primary regulatory mandate. APEGBC establishes, maintains and enforces standards for the qualifications and practice of its members and licensees. This includes those practicing in the field of electrical engineering.

Attachment 3: Installation Flowchart for Public Charging



Source: BC Hydro Charging Infrastructure Guidelines
http://www.bchydro.com/about/sustainability/climate_action/plugin_vehicles/charging___infrastructure.html

Attachment 4: Commercial Public Cost Worksheet

This table provides a generic cost table for a public Level 2 charging station for two charging locations located side-by-side.

Public Charge Station - Level 2 (Qty 2)			
Description	**Quantity**	**Cost, Ea**	**Total**
Labor (hrs)			
Consultation with Property Owner/Tenant	4	$ 75.00	$ 300.00
Initial Site Visit	2	$ 75.00	$ 150.00
Engineering Drawings	16	$ 90.00	$ 1,440.00
Permit Application / Acquisition	2	$ 75.00	$ 150.00
Installation	24	$ 75.00	$ 1,800.00
Approval	2	$ 75.00	$ 150.00
Labor Sub-Total			$ 3,990.00
Materials			
Distribution Sub-Panel (100Amp)	1	$ 250.00	$ 250.00
EVSE - 40Amp	2	$ 780.00	$ 1,560.00
EVSE Pedestal	2	$ 450.00	$ 900.00
40amp Breaker	2	$ 35.00	$ 70.00
#12 THHN Wire	400	$ 0.30	$ 120.00
Conduit - 3/4 EMT	100	$ 3.00	$ 300.00
40Amp Fused Disconnect	2	$ 115.00	$ 230.00
Ground Signage & Striping (painted)	2	$ 125.00	$ 250.00
Signage (Post Mount)	2	$ 250.00	$ 500.00
Miscellaneous	2	$ 60.00	$ 120.00
Material Sub-Total			$ 4,300.00
Trenching & Repair	100	$ 45.00	$ 4,500.00
Permit	1	$ 85.00	$ 85.00
		Total	**$ 12,875.00**

Source: BC Hydro Charging Infrastructure Guidelines
http://www.bchydro.com/about/sustainability/climate_action/plugin_vehicles/charging___infrastructure.html