

Charging Electric Vehicles

Developing Policy Options to Accommodate the at Home Charging of Garage Orphan Electric Vehicles in the Metro Vancouver Region

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Executive Summary

The City of Vancouver and Metro Vancouver wish to develop a strategy to facilitate the at home charging of electric vehicles (EVs) where their owners do not have on-site parking but rather park their cars on the street when at home.

To facilitate this, it is recommended that:

1. The City allow for power at 240 volts to be provided from the EV owner's home to a vehicle charging station located in the boulevard in front of the owner's home;
2. A standard be developed such that a charging station can be installed in a cost-effective manner;
3. Reserved EV parking be provided in front of the charging station;
4. The permitting system for the charging station be administratively simple; and,
5. BC Hydro be encouraged to adopt a time of use billing program and review its billing framework and other practices to assure support for EV owners.

Further, it is recommended that:

1. The City of Vancouver proceed with a pilot project to encourage and facilitate the ownership of EVs; and
2. Utilizing lessons learned from the pilot project, that the program be rolled out across the entire City as soon as possible.

Introduction

In two recent reports, the *Greenest City 2020 Action Plan* and *Renewable City Strategy*, Vancouver has set out a variety of strategies to meet its objective of an 80% reduction of community-wide GHGs and for all energy to come from renewable sources (Vancouver, 2015). Strategies are aimed at buildings, waste reduction, local sourcing of goods and transportation. In the area of transportation, there are a number of strategies including encouraging the use of electric vehicles (EVs). This paper addresses the charging of electrical vehicles, which are garage orphans (GOEVs).¹ Garage orphans are vehicles owned by someone without access to parking on their property, and thus they are parked on the street near the owner's home.

Research Methodologies

An ideal approach to the charging of GOEVs in Vancouver could not be found in one place; therefore a multi-faceted approach was used to develop an efficient, applicable strategy. The first step was to follow an academic approach in order to learn more about the topic and what is currently being done elsewhere. The results from this examination are discussed in the literature review section. The next step was to determine what is important to the people currently facing the issue of charging GOEVs. This was accomplished primarily through an online survey, distributed to individuals who had previously reached out to the City of Vancouver and also through the Vancouver Electric Vehicle Association (VEVA). Following the survey, expert interviews were undertaken with City of Vancouver and Metro Vancouver staff and with an executive from VEVA. Finally, prime neighbourhoods for the installation of GOEV charging stations were examined and photographed.

¹ To avoid confusion, the term 'charging' will refer to the charging of the electric vehicle, while 'billing' will refer to the monetary cost associated with charging.

Literature Review

Preamble

It is only in the past few years that EVs have become commercially viable and thus issues related to their use, and specifically the charging of EVs (and more specifically the charging of GOEVs), are very recent. As a result, it was necessary for this literature review to go beyond academic papers and to include books, technical reports, government sources and BC Hydro's website. The first section of this Literature Review provides background information on the charging of EVs which provides useful context for the development of appropriate policies and procedures for the charging of GOEVs. The second section deals specifically with the logistics of charging GOEVs.

Part 1 – Background

Technical

Based upon the literature review, it can be concluded that there is general consensus on a number of important technical matters related to or impacting the charging of EVs.

One fundamental question is whether the existing capacity of BC Hydro infrastructure will accommodate the increased power demand from charging EVs. While information was not available specifically for Vancouver, there is ample evidence in the literature that charging EVs at home will not place an unmanageable burden on the existing grid. Motavalli illustrates this well when he references a 2006 US Department of Energy study which estimated that the US power grid could fuel 180 million plug-in hybrid vehicles (84% of the current total number of vehicles), assuming that they were plugged in at night (Motavalli, 2011).

On the question of where and when GOEVs are typically charged, the consensus opinion is that there is a strong preference for them to be charged at home and typically at night. (Lane, 2015). In fact, given the increased range that EVs are able to travel on a single charge (Figure 1), it is likely that for many EV owners, all of their charging will be done at home.

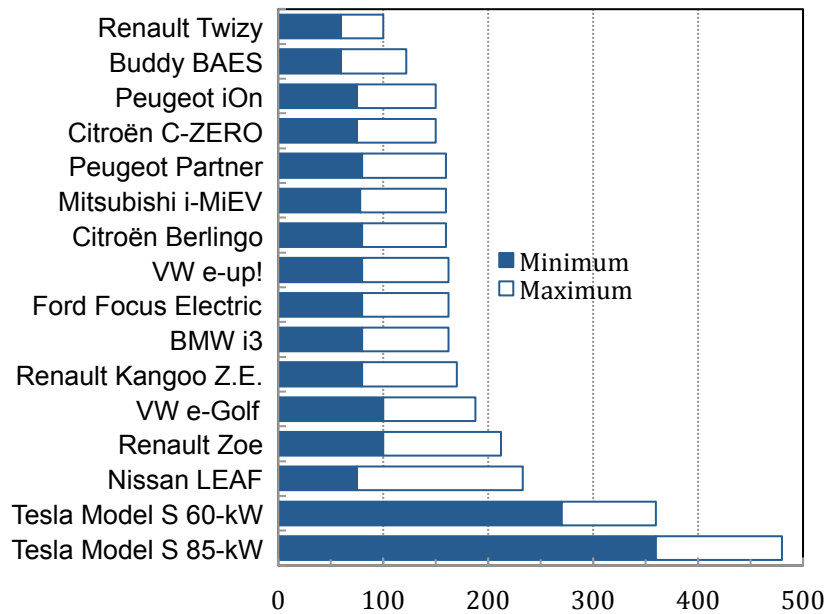


Figure 1 The Minimum and Maximum Range of EVs per Charge, km (Norwegian Electric Vehicle Association, n.d.)

The final technical question on which there was consensus is at what voltage should EVs be charged at home? Charge times at various voltages are illustrated in Table 1. Of the available options and considering a number of variables, it is apparent that a 240-volt charging system, with a 3 to 6-hour charge time, is the most suitable for home use and for GOEVs. All of these conclusions support, and are supported by the smart grid discussion which follows.

Charging Station Level	Typical Charging Time	Likely Location
Level I: 110V	10-20 hours (0-100%)	Homes, workplace charging, parking garages, long-term & overnight lots
Level II: 220V	3-6 hours (0-100%)	Homes, shopping centres, parking garages, institutions
DC/Fast Charge: 480V+	20-40 minutes (0-80%); 1 hour for 100%	Commercial; shopping centres, public locations with high customer traffic

Table 1 Charging Times Based on Voltage (Hydro Quebec, 2015)

Smart Grid

A smart grid is a concept that is often discussed, but not widely understood. According to the Electric Power Research Institute, a smart grid is “one that incorporates information and communications technology into every aspect of electricity generation, delivery and consumption in order to minimize environmental impact, enhance markets, improve reliability and service, and reduce costs and improve efficiency” (Islam, 2013). With their significant storage capability, EVs can be valuable elements of a smart grid system. Mitchell suggests that theoretically an EV go grid to vehicle (G2V) (charge) when electrical system demand is low (typically at night) and vehicle to grid (V2G) (supply to grid or discharge) when demand is high, providing both environmental and economic benefit (Mitchell et al, 2010). This interchangeable flow allows the EV when plugged in to facilitate ‘peak shaving’. Peak shaving involves either reducing peak demands, or in this situation, providing power locally to the grid from the EV, effectively creating a distributed generation model. This approach is supported by BC Hydro’s Smart Meter program – objectives of which include the establishment of a two-way grid, greater use of green energy and the support of the use of EVs. (BC Hydro, 2016)

Part 2 – Charging GOEVs

Policy

While there is general agreement on the technical aspects of charging EVs, opinions on where and how to charge GOEVs are radically different. At one end of the spectrum, the City of Seattle, after thoroughly investigating strategies to provide home-based charging for EVs, concluded that on-street charging is not a viable option due to concerns with installation logistics and parking (NelsonNygaard Consulting Associates Inc., 2014). Instead, it proposes vehicles be charged at work or in public or private lots at charging hubs near the GOEV owner’s home. The Cities of Boston and London acknowledge that there are issues to overcome for on-street charging, but have not ‘written it off’ as Seattle has (Salama et al, 2015).

Philadelphia, at the opposite end of the spectrum to Seattle, has developed a simple, but effective solution for on-street charging of GOEVs. It consists of a straight-forward, three-page application form available online, and a simple and easy-to-understand application guide (Philadelphia, 2013). As Philadelphia's approach matches Vancouver's objective, it is viewed as a model worthy of further review, adaptation and adoption. A copy of Philadelphia's application form is provided in Appendix A.

Logistics

The need to cross the sidewalk with an electrical cable without creating a tripping hazard is one of the principle challenges that must be addressed in the development of charging stations for GOEVs. Where a sidewalk is not present, the charging cord can simply be run overland from the home to the car. When a sidewalk is present, which is the case in most locations where GOEVs are parked, potential solutions range from simple to elegant (and expensive):

- A simple post with a lockable waterproof electric receptacle;
- A receptacle attached to a light pole or other pole;
- A covered trench crossing of the sidewalk; and,
- A recessed or a pop-up receptacle.

(Lane, 2015 & Philadelphia Parking Authority, 2013)

In most cases it will be possible to locate the receptacle in the boulevard (grassed area between sidewalk and curb) as illustrated in Figure 2. Where the sidewalk is adjacent to the curb, a more complex and costly solution is required. Although the boulevard is City property, it is not uncommon for the City to allow the placement of private infrastructure in the boulevard.



Figure 2 Boulevard in a Typical Garage Orphan Neighbourhood (Webb, 2016)

Parking

Ensuring there is access to parking at or near the EV owners' receptacle is a significant concern and one of the reasons that Seattle did not pursue on-street charging. From the literature, it appears that this remains a topic for future discussion in many jurisdictions. If the City wishes to incent GOEVs, however, it must provide reserved parking in front of the charging station. Figure 3 is the standard signage utilized in Philadelphia.



Figure 3 Reserved Parking Sign for Electric Vehicles (Philadelphia Parking Authority, 2013)

Online Survey and Expert Interviews

Information was gathered from two primary sources: an online survey geared towards knowledgeable individuals currently owning or considering the purchase of an EV; and, interviews conducted with experts, both in terms of EVs and the City of Vancouver and Metro Vancouver. The survey and expert interviews were conducted in accordance with the UBC Behavioural Research Ethics Board Requirements and under the TCPS guidelines.

Survey Results

Table 2 shows the key results from the online survey. The numbers in brackets indicate the number of respondents for each question. The table also states the percentage of respondents who selected each particular response (rounded to the nearest percentage point). The survey questions are provided in Appendix B. The survey was circulated online to citizens of Vancouver, to both EV owners and non-EV owners. EV owners were targeted to be aware of their current charging habits and the problems they face, while non-EV owners were asked question in order to determine what barriers they face when considering purchasing and EV.

The results of the survey support both the information found in the literature review and the approach recommended in this paper.

Electric Car Ownership and Charging Preferences

After Q2, EV owners answered Q3-10; those not owning an EV skipped to questions A to D. In brackets after each question is the number of valid responses. For each option, the share of responses was rounded to the nearest percent.

1. Are you a resident of Vancouver? (12)	Yes	67%
	No: Toronto	8%
	No: Norway	8%
	No: Not Stated	17%
2. Do you drive an electric vehicle (EV)? (13)	Yes	46%
	No	54%
3. How often do you charge your EV per week? (4)	1-3 times	25%
	4-7 times	50%
	7+ times	25%
4. At what voltage do you charge your EV? (4)	120V	25%
	240V	75%
5. Where does the majority of your charging take place? (3)	Work	33%
	Home	33%
	Public Charging Station	33%
6. Access to a permanent parking spot at home, such as garage, driveway, underground parking? (5)	Yes	20%
	No	80%
7. Type of residence? (1)	1-2 family	100%
8. If the majority of charging occurs at home, how is it done? (3)	Charging cord, home to EV	67%
	Charging station at street	33%
9. Distance from home willing to park EV to charge it? (2)	100-300 m	50%
	300-500 m	50%
10. If you could install a charging station in front of your home, how much would you pay for installation? (2)	\$0	50%
	\$2,000 - \$4,000	50%

Comments from EV Owners

"I would like to be able to plug my car in from the front of my house, safely."

For respondents not owning an EV

A. Do you plan or have an interest in buying an EV in the next twelve months? (7)	Yes	86%
	No	14%
B. Current type of residence? (1)	1-2 family	100%
C. Do you have simple access to home charging an EV? (1)	No	100%
D. If "no" to Question C, would the effort/lifestyle change prevent you from switching to an EV? (1)	Yes	100%

Comments from Individuals not owning an EV

"Since I don't drive to work, currently the only way for me to charge an EV is to buy a different house and I'm not willing to do that. But if either the City of Vancouver or BC Hydro changed their regulations to allow me to install a charging station in front of my house at my own expense then I would do it."

Table 2 Results from the Online Survey

Expert Interview Results

Ian Neville, City of Vancouver, Climate Policy Analyst

Mr. Neville is working hard to promote the use of EVs in Vancouver. The growth rate of EVs is very promising. In 2011 there were 12 registered EVs, in British Columbia, and now there are 3500. On one hand these numbers are very positive; however, on the other they are a clear indication of the appeal of EVs and as a result the need for charging solutions for all including GOEV owners. In addition to the comparatively high cost of EVs, GOEVs in particular, also face a significant capital cost for the charging infrastructure that is required. Regardless of the solution found, the capital cost of infrastructure to charge GOEVs will be higher than for non-garage orphan EVs.

There has been a strong push for the City and the Province to financially assist owners with the cost of charging infrastructure.² Unfortunately, there are no subsidies available for the installation of the charging station itself; however, there is the possibility that a payment plan could be developed by the City to help with this financial burden.

Mr. Neville also addressed the aesthetic effect that GOEV charging stations would have on GOEV neighbourhoods. Mr. Neville outlined two potential ways of mitigating this concern; the first is to provide guidelines in terms of width, height and other parameters. The second is to use a standard design for all of the boulevard stations. In this regard The City has discussed the possibility of creating an industrial design course project with academic institutions.

Brad Badelt, City of Vancouver, Senior Sustainability Specialist

Mr. Badelt was very informative about how a pilot program could be operated,

² BC currently offers a provincial rebate of up to \$5,000 on an EV purchase, and funds the *Scrap-It* program for EV purchasers willing to scrap a vehicle from 2000 or earlier.

certain number of participants would be allowed in the program; however, the pilot program could be expanded to meet demand.

The recommendation that the charging station be installed in the boulevard creates an issue as it involves the installation of a private piece of property in a public space. Mr. Badelt explains that this does not mean that it cannot happen, rather that a legal agreement is required. This required process is compared to that of restaurants and bars that have a patio on the sidewalk, once again a piece of private property situated in a public space. Mr. Badelt explains that the agreement would be between the City and the owner, with the owner assuming responsibility and liability for the station and being required to provide liability insurance.

Eve Hou, Metro Vancouver, Air Quality Planner

Ms. Hou emphasized that current EV owners are the enthusiasts and early adopters of this technology. Because of this, they are much more willing to make compromises to adopt new practices even if they are not entirely convenient. Keeping in mind that Metro Vancouver's goal is to encourage EV ownership, she believes that removing barriers to increase the simplicity of the charging process is paramount, as the next round of EV owners will not share the same enthusiasm for the vehicles. They will demand a reasonable degree of convenience.

Suzanne Fairley, Citizen and VEVA Executive

Speaking with Ms. Fairley provided the perspective of individuals currently trying to overcome the challenges of charging their GOEVs. Ms. Fairley described two scenarios in which GOEV owners attempt charging solutions. The first involves running a cable from the house to the vehicle (similar to the proposed recommendation), but using a mat to cover the portion of the cable crossing the sidewalk. The second is to rely on the public charging stations that are currently located around the Vancouver area. Neither are sustainable solutions; the former because the mat and the cord are still tripping hazards in a public space and the latter because EV owners wish to charge their vehicles at home, as demonstrated by the literature and survey results.

Ms. Fairley is eager to find a solution, with the goal, that all homes have the same access to charging stations. This equal accessibility also includes addressing financial implications. Ms. Fairley believes that the cost of GOEV charging stations should be paid for by the City in order to provide this equal access.

Field Observations

Finally, field observations were conducted in garage orphan neighbourhoods to evaluate whether the approach being considered was feasible. Figure 4 illustrates a typical situation. The proposed approach will work well.



Figure 4 Boulevard in a Typical EV Neighbourhood Where a Charging Station Could be Installed (Webb, 2016)

Recommendations

Principal Recommendations

Based upon the results of an international literature review, a survey, an interview of a knowledgeable user, client interviews and field observations, the following recommendations are made and rationale provided to facilitate at home charging of GOEVs, and through this encourage the purchase of EVs by residents who do not have on-site parking.

1. *The City allow for power at 240 volts be provided from the GOEV owner's home to a vehicle charging station located in the boulevard in front of the owner's home.*

Power is readily available from the GOEV owner's home at 240 volts. Utilizing 240 volts allows relatively quick charging and would support coupling the GOEV with a Smart Grid system to the maximum benefit of all. Locating the charging station in front of the GOEV owner's home will allow power to come from their home and will maximize owner convenience.

2. *A standard be developed such that a charging station can be installed in a cost effective manner.*

Developing standard designs and applications will be helpful to both applicants and City administrators. A cost effective design (a buried wire and a weather proof plug on a wooden post) is practical as there is no need for metering at the charging station as this is done via the GOEV owners home metering system. See Figure 5 for a conceptual charging station design.

3. *Reserved EV parking be provided in front of the charging station.*

Providing reserved parking in front of the GOEV owner's home is a critical and mandatory part of an on-street GOEV charging system. It enables the owner to be confident that they will be able to park at their charging station to charge their vehicle. This convenience should serve as a significant incentive to owning an EV. The Province's recently announced program to readily distinguish EVs to allow them access to HOV lanes is aligned with this initiative. While reserved parking is considered critical to the success of the recommended GOEV charging strategy, it is understood that the concept of reserving parking at all times might generate resistance, particularly in areas where on-street parking is at a premium. If necessary, the reserved parking could be time limited (say from early evening to early morning) as most charging is expected to occur at night. When it is possible to realize all of the Smart Grid benefits of EVs (and there are many more EVs) this approach could be reconsidered.

4. The permitting system for the charging station be administratively simple.

A system which does not 'bog an applicant down in red tape' will be appreciated by GOEV owners helping to encourage EV ownership. Efficiency for the City is another important consideration.

5. BC Hydro be encouraged to adopt a time of use billing program and otherwise provide support for EVs.

BC Hydro has just completed its installation of Smart Meters. Time of use billing is a logical companion to Smart Meters as it clearly communicates the benefits for those who use power (in this case to charge their vehicles) in off-peak periods. The current stepped billing system that could penalize EV users even if they charge at night, should be reviewed.

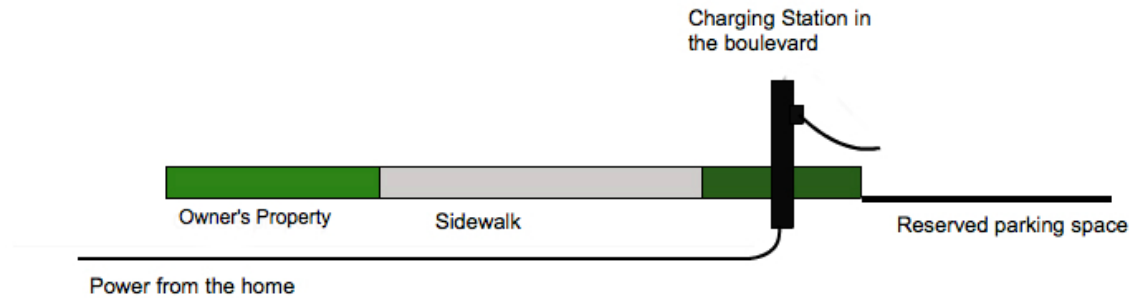


Figure 5 Schematic of a Possible Vancouver Charging Station Design (Webb, 2016)

Further, it is recommended that:

1. *The City of Vancouver proceed with a pilot project to encourage and facilitate the ownership of GOEVs.*

A pilot project will be quicker to roll out than a full program. A pilot program will allow minor issues to be resolved before the full program is rolled out.

2. *Utilizing lessons learned from the pilot project, that the program be rolled out across the entire City as soon as possible.*

The quicker the full program can be rolled out, the quicker GOEV ownership can be encouraged and the greater the environmental benefit.

Additional Recommendations and Areas for Further Research

The following are additional recommendations and suggested future research topics which could increase the appeal of EV and GOEV ownership:

- BC Hydro and the City of Vancouver should develop a fully integrated smart grid/EV interface, which will allow and encourage V2G as well as G2V operations.

Although not critical to the start of this program, this would further develop the economic and environmental benefits of switching to an EV. Additionally this would serve to optimize the infrastructure that BC Hydro has already begun installing.

- The City should monitor, and as required, improve its GOEV home charging policies and procedures.
- The City should consider subsidizing and also seek subsidy from others such as the Province, BC Hydro or the federal government.

Remembering that solving the issue of charging for GOEVs is just one step in encouraging EV ownership among its citizens. Due to the higher cost of adopting this greener technology, economic incentives are powerful tools to remove barriers for potential owners. If Vancouver wishes to continue to lead the way for green cities, it must be willing to help its citizens make the changes necessary to remain at the leading edge.

Imagining the Future

Installing a charging station will be a significant expense to GOEV owners, even if the recommendations in this report are followed. This leads to the question, given how fast technology is advancing, will a new charging system soon be developed making the proposed charging stations obsolete? The following section addresses why these charging stations will remain relevant in the coming years.

In just a few short years, electric vehicles have evolved from being a ‘fringe’ mode of transportation to a viable option, increasingly mainstream. Two days after the release of Tesla’s Model 3, 276,000 vehicles were ordered (Newcomb, 2016). The ever-increasing adoption momentum is fuelled by a number of factors including greater vehicle range, government incentives (financial, access to HOV lanes and more), broader choice and society’s rising climate change concerns.

Notwithstanding the increase in the number of public charging stations, it is anticipated that charging at home, typically overnight, will still be the preferred method of charging for most users. At the same time as EV usage is increasing, the adoption and development of smart grids is advancing to the point that soon they too may have a higher profile in Vancouver. At home charging of EVs and smart grids are ideal partners. It is not hard to imagine the scenario where the smart grid and the plugged in EV are in constant communication – the vehicle being re-charged (G2V) when demand on the grid is low and the vehicle powering the grid in a distributed generation model (V2G) when demand on the grid is high.

We are already seeing this potential increase with the teaming up of two companies, ChargePoint and Nest (Ruff, 2016). ChargePoint is a leading EV infrastructure company, while Nest is a pioneer of the home automation system, with a particular strength in smartphone integration. This provides further opportunity for owners to be charging their EVs in the most sustainable method possible, while ensuring the ease and convenience that people have come to expect with technology.

Based upon this glimpse of the possible (and not unlikely) future, it is hard to imagine reaching a point where connecting GOEVs to the owner's home would not make sense.

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Appendices

Appendix A Philadelphia's Electric Vehicle Parking Space Application

The three-page application from the Philadelphia Parking Authority for the reserved parking spaces in front of charging stations.

		ELECTRIC VEHICLE PARKING SPACE APPLICATION	
701 Market Street, Suite 5400 Philadelphia, Pa 19106 Phone #: 215-683-9738 Fax #: 215-683-9809		Date of Application: ____ / ____ / 20__	
Applicant's Name: _____			
Mailing/Billing Address: _____ (Street Address) (City) (State) (Zip Code)			
Contact Information: Phone #: _____ E-mail Address: _____@_____			
Proposed Electric Vehicle Parking Space Information			
Address: _____ (Street Address) (City) (State) (Zip Code)			
Are you the owner of the address for the proposed electric vehicle parking space? Yes No *If No, please obtain consent from the property owner of the proposed address, stating that they have no objection to an electric vehicle parking space being installed on their property on the attached consent form.*			
Is the proposed property 20 feet in width? Yes No *If No, please obtain consent from one of your neighbor's, stating that they have no objection to an electric vehicle parking space infringing upon their property on the attached consent form.*			
Please fill in the following vehicle information:			
Make: _____ Model: _____ Year: _____ Vehicle Length: _____ Feet			
The following information is to be included with this application. Failure to include any of these items will result in the return of the application. Your application will not begin to be processed until all correct and complete information has been received.			
<ul style="list-style-type: none">➤ Vehicle Registration: registered to the address where the space is sought➤ One of the following:<ul style="list-style-type: none">○ Driver's License: showing the address where the space is sought○ Either two utility bills or a typed lease to the address where the space is sought➤ Aforementioned consent of property owner or neighbor➤ A clear photograph showing the entire area in which the electric vehicle parking space would be located, and the front of all property abutting the proposed electric vehicle parking space➤ \$50 Non-Refundable Application Fee made payable to the "Philadelphia Parking Authority"			

UPON APPROVAL BY THE PHILADELPHIA PARKING AUTHORITY

After the Philadelphia Parking Authority has determined that an electric vehicle parking space is practical, the applicant must apply to the Department of Licenses & Inspections (L & I) for a curb side electric outlet. Below are code requirements and recommendations from the Department of Licenses & Inspections

- Installations shall follow the current National Electrical Code and must be performed by a Licensed Electrical Contractor with an electrical permit from Licenses & Inspections
- All conductors and equipment used for this installation, including the cord used to connect the vehicle to the receptacle, shall be approved, identified, labeled and listed suitable for the specific purpose, environment and application
- Receptacle must be located on a dedicated branch circuit with ground fault circuit protection located in the main panel
- A shut-off switch for the receptacle must be installed inside the building at the exit
- The receptacle must be tamper-resistant and located within an outdoor, weatherproof, hinged, lockable enclosure to prevent accidental or intentional contact
- Location of receptacle must be no higher than 48 inches
- There shall be no commercial uses associated with the use of the receptacle
- Electrical permit from L & I must be obtained prior to installation of electrical box

UPON APPROVAL BY THE DEPARTMENT OF LICENSES & INSPECTIONS

After the installation of a properly functioning Electric Vehicle Charger, the Philadelphia Parking Authority will post the required signs designating the Electric Vehicle Parking Space

REQUIREMENTS & POLICIES REGARDING AN ELECTRIC VEHICLE PARKING SPACE

- The proposed EVPS must be no more than 20 feet in length, unless a greater length is necessary, based on the size of the vehicle
- The proposed EVPS shall not be in any location where parking is currently prohibited by state or local law
- The proposed EVPS shall not be in any location where parking is currently prohibited by state or local law
- No garage, driveway, or other location not in the right of way is available to the applicant for parking of the Electric Vehicle
- The number of reserved on-street parking spaces, of any kind, on a hundred block, does not exceed:
 - On blocks with single-sided parking: three (3)
 - On blocks shorter than 500 feet in length, with parking on both sides: four (4)
 - On blocks that are 500 feet or longer in length, with parking on both sides: five (5)
- The Philadelphia Parking Authority shall not approve an EVPS where the applicant is liable for any delinquent fines or penalties (i.e., has three open tickets or more)
- Installation Fee, to be paid upon approval by the Department of Licenses & Inspections:
 - Center City & University City area:
 - \$500 per metered space removal or \$250 per 20 feet of space
 - All other areas of the city:
 - \$300 per metered space removal or \$150 per 20 feet of space
- Yearly Renewal Fee:
 - Center City & University City area: \$150 per year
 - All other areas of the city: \$75 per year
 - An EVPS may be revoked, and the EVPS and EVC may be removed by the Philadelphia Parking Authority if such yearly renewal fee is not timely paid in accordance with the program

- The person to whom an EVPS has been issued shall immediately notify the Philadelphia Parking Authority, and the EVPS may be immediately revoked, if any of the following events occur:
 - The registration or license plate is transferred to a Non-Electric Vehicle
 - The Electric Vehicle is transferred to another owner who does not reside at the address for which the EVPS was established
 - The owner of the Electric Vehicle ceases to reside at the address for which the EVPS was established
- An EVPS may be revoked under any of the following circumstances:
 - Any condition necessary for the grant of the EVPS under the regulation ceases to be met
 - The EVC or its associated wiring is not maintained in good repair or presents a hazard due to deterioration, malfunction, or improper use
 - Any excavation of the right of way for installation or maintenance of the EVC or associated wiring is not properly restored
- An EVPS should not be treated as a personal parking spot. Anyone with an electric vehicle is allowed to park in the EVPS. Any abuse of the EVPS (i.e., cones, telling other electric vehicle operators they are forbidden to park in the EVPS, etc.) will result in the removal of the space.

CONSENT OF PROPERTY OWNER

I, (print name) _____, certify that I am the owner of
 (address) _____.
 I understand that my tenant is applying for an Electric Vehicle Parking Space. If approved, I have no objections to the Philadelphia Parking Authority installing a sign on the sidewalk in front of my property in order to designate such a zone.

Signature: _____ Date: _____ Telephone #: _____

CONSENT OF ADJACENT PROPERTY OWNER

I, (print name) _____, certify that I am the owner of
 (address) _____.
 I understand that my neighbor is in need of additional footage in order to install an Electric Vehicle Parking Space. I have no objections to the Philadelphia Parking Authority installing a sign on the sidewalk in front of my property. I am aware that the footage required may be as little as 2 feet to a maximum of 15 feet depending on the width of my neighbor's home.

Signature: _____ Date: _____ Telephone #: _____

CONSENT OF ADJACENT PROPERTY OWNER

I, (print name) _____, certify that I am the owner of
 (address) _____.
 I understand that my neighbor is in need of additional footage in order to install an Electric Vehicle Parking Space. I have no objections to the Philadelphia Parking Authority installing a sign on the sidewalk in front of my property. I am aware that the footage required may be as little as 2 feet to a maximum of 15 feet depending on the width of my neighbor's home.

Signature: _____ Date: _____ Telephone #: _____

Appendix B Citizen Questionnaire

Question 1

Are you a resident of Vancouver?

- ☐ Yes
- ☐ No (please state where) _____

Question 2

Do you drive an electric vehicle (EV)?

- ☐ Yes
- ☐ No

Question 3

How often do you charge your EV?

- ☐ 1-3 times per week
- ☐ 4-7 times per week
- ☐ 7+ times per week

Question 4

At what voltage do you charge your EV?

- ☐ 120V
- ☐ 240V
- ☐ 480V

Question 5

Where does the majority of your charging take place?

- ☐ At home
- ☐ At work
- ☐ Public charging stations
- ☐ Other _____

Question 6

Do you have access to a permanent parking spot at home, such as garage, driveway, underground parking, etc.?

- ☐ Yes
- ☐ No

Question 7

Do you currently live in a...

- ☐ 1- or 2- family home
- ☐ Multi-family building

Question 8

If the majority of charging occurs at home, how do you accomplish this?

- ☐ Running charging cord from home to EV
- ☐ Charging station at the street
- ☐ Other _____

Question 9

How far are you willing to park your car from your home to be able to charge it?

- ☐ 0-100m (0-2 minutes)
- ☐ 100-300m (2-4 minutes)
- ☐ 300m-500m (4-8 minutes)
- ☐ 500-1,000m (8-15 minutes)
- ☐ 1,000m + (15 minutes+)

Question 10

If you could install a charging station on the street in front of you home how much would you be willing to pay to install it?

- ☐ \$0
- ☐ <\$2,000
- ☐ \$2,000-\$4,000
- ☐ >\$4,000

Question 11

Do you have any additional comments, suggestions, etc.?

Question 12

If you feel this is an important issue, what do you feel is important for your government and representatives to know?

Question A

Do you plan on or have interest in buying an EV in the next 12 months?

- ☐ Yes
- ☐ No

Question B

Do you currently live in a...

- ☐ 1- or 2- family home
- ☐ Multi-family building

Question C

Do you feel you have relatively simple access to home charging for an EV?

- ☐ Yes
- ☐ No

Question D

If no for the question above, would the effort/lifestyle change required to have home charging prevent you from switching to an EV?

- ☐ Yes
- ☐ No

Question E

Are there any additional comments you have concerning EVs and charging options for garage orphans?