EXECUTIVE SUMMARY
The Smart Growth Committee has reviewed additional information about electrical vehicle charging infrastructure (EV infrastructure) in response Council’s questions raised when it had first considered the proposal on October 10\textsuperscript{th}. Committee continues to recommend that the City require EV infrastructure be roughed-in at the time of construction of new residential dwelling units.

RECOMMENDATIONS
The Smart Growth Committee recommends to Council that the Zoning Bylaw be amended as described in the November 9, 2017 staff report to the Smart Growth Committee, “Electric Vehicle Charging Bylaw Amendments”.

COMMENTS AND ANALYSIS
Committee further discussed the potential costs and benefits of requiring EV charging infrastructure at its meeting held November 16\textsuperscript{th}, 2017 and its recommendation to proceed to Council is not unanimous. Committee questioned the estimated cost to install the infrastructure when constructing a new single family home and was informed that the rough-in cost noted in the staff report is the best estimate available. The Environmental Coordinator further notes the estimated cost is low as it can be primarily attributed to incremental labour and materials when a builder is already running wires from the house to the garage. In response to a question about what other communities are requiring, Committee was advised that the City could be the first to be require roughed-in Level 2 EV infrastructure for all dwelling units, while other cities such as Richmond, Vancouver and City of North Vancouver are looking at similar, or more comprehensive requirements. Lower Mainland communities are looking at options to encourage electric vehicle use such as by providing as publicly accessible locations for charging (as noted in the previous report to Council from SGC, staff will also be
investigating a pilot project for this purpose in partnership with the Downtown Business Improvement Association).

**OPTIONS**

Council may:
1. Determine it wishes to consider an amendment to the Zoning Bylaw by adopting SGC’s recommendation;
2. Determine it still does not have enough information to make a decision and request that SGC provide additional information;
3. Determine it does not wish to amend the Zoning Bylaw to require roughed-in EV infrastructure as proposed.

_____________________
Laura Lee Richard on behalf of the Chair, Smart Growth Committee

Attachment:
1. Staff report to SGC dated November 9th, 2017
EXECUTIVE SUMMARY
At its meeting held on October 10th, 2017 Council considered the report from SGC recommending that the Building and Plumbing Bylaw be amended to require electrical vehicle charging (EV) infrastructure. Prior to making a decision on the recommendation, Council requested that SGC provide additional information to answer three questions:

- What would be required for installation of EV infrastructure?
- What would it cost for EV installation? and,
- When would the new requirement be applied to proposed developments?

This report provides a response to these questions as well as a proposal for the bylaw amendment. While it does not suggest any changes to SGC’s original recommendation to require roughed-in EV infrastructure to service new residential dwelling units, it recommends that the Zoning Bylaw be amended for this purpose rather than the Building & Plumbing Bylaw.

RECOMMENDATION:
The Smart Growth Committee recommends to Council that the Zoning Bylaw be amended as described in the November 9th, 2017 staff report to the Smart Growth Committee, “Electric Vehicle Charging Bylaw Amendments”.

COMMENTS AND ANALYSIS
Response to Council’s Questions
(1) What would be required for installation of the infrastructure?

Roughing-in EV charging infrastructure involves several components with specific functions: an outlet box is a terminal where a charging station can be attached; a raceway is protective housing where wires are placed; breakers are safety switches
attached to an electrical panel, which distributes power; a meter measures power use (provided and installed by BC Hydro); and, a switchboard distributes power to the panels. Transformers adjust electrical voltage for use, at the street or building level.

In the construction of new ground-oriented housing (single and two-family homes; townhouses with individual parking spaces), providing EV charging infrastructure to each dwelling unit would mean installation of a breaker on the unit’s electrical panel, an outlet box in the parking area, and raceway connecting the panel to the outlet.

In new buildings with residential uses and a common parking area (apartments and mixed-use buildings), the developer would be required to install an electrical panel with breakers, outlet boxes, a raceway connecting the breaker to the outlet box, and an electrical meter with disconnect. The outlet boxes could be shared by up to eight parking spaces (i.e. 8:1 load sharing). Depending on the building, installation of the infrastructure may require additional space in the electrical room and upsizing the transformers and switchboard.

Residents wishing to enable the EV charging from a roughed-in installation would need to add wiring in the raceway, connect wires from the breaker to the outlet, and attach a charging station to the outlet.

(2) **What would it cost to the developer / homeowner?**

Determining the cost of EV rough-ins involves calculation of unit electrical loads (which dictate transformer and switchboard sizing), to which costs are added for the installation of equipment and additional electrical room space, as applicable. Costs presented are derived from those calculated by the Cities of Richmond and North Vancouver using the requirements specific to Port Coquitlam’s proposed amendments. In ground-oriented housing, rough-in costs are estimated to be $80 to $90 per parking space. In buildings with multi-family dwelling units sharing a common parking area, the cost will depend on building power requirements and parking configuration. For example, a building with a relatively efficient parking layout may be able to achieve an average of six parking spaces connected to one outlet (6:1 load sharing). For this example, costs are estimated to be between $272 to $470 per roughed-in parking space. If the parking configuration is less efficient and only allows for a 4:1 load sharing, costs could range from $402 to $698 per space. The pattern of recently constructed multi-unit buildings in Port Coquitlam indicates that most would not require transformer upsizing for roughing-in, meaning that costs are likely to fall at the lower end of these estimates.
BC Hydro offers a contribution of up to $200 per kW of projected billing demand for developments connecting to a new power supply, which is typical for most new multi-family structures. This would equate to a maximum of $250 (6:1 load sharing) or $332 (4:1 load sharing) per space towards the extension and could substantially reduce the cost of eligible installations.

(3) When would the new requirement be applied to new development?

It is proposed that the requirement for EV infrastructure apply to all new building permit applications submitted 6 months after the Zoning Bylaw amendment is adopted. This timing should be sufficient for most developers and builders to include the new requirement as part of their original set of building permit and electrical drawings. It will be important that the City provide good communications of the requirement, especially to builders of single family homes.

The proposal to apply the regulation 6 months after adoption means that most in-process rezoning and development permit applications will need to include the infrastructure. Staff do not recommend they be exempted because the cost for roughed-in infrastructure is relatively minor and unlikely to significantly impact the developers’ pro formas. However, extending the exemption to in-process applications is an option to be considered if Committee wishes to only apply the new requirement to new projects.

In addition to these questions, a variety of other concerns were noted during the Council discussion. The background material originally provided to Committee and included in the public consultation process addressed many of these concerns. It has been updated and it is recommended that this material be included in the Committee’s report to Council as further information.

Proposed Bylaw Amendment
Staff’s further review of regulating EV infrastructure requirements has determined that it would be most appropriate to include the new requirement in the Zoning Bylaw, rather than the Building and Plumbing Bylaw as previously suggested. The following amendments to the bylaw are proposed:

Adding the following definition:

“Roughed-in electric vehicle charging Infrastructure” means a Level 2 service including a 240v or 208v circuit breaker on an energized electrical panel connected by raceway to an outlet.
Adding the following regulations:

1) One parking space per dwelling unit shall be provided with roughed-in electric vehicle charging infrastructure including an electrical outlet box located within 3 metres of the unit’s required parking space.

2) In a building with a common parking area, such as an apartment building or building with a mix of commercial and residential uses, a separate single utility electrical meter and disconnect shall be provided in line with the electrical panel(s) intended to provide for charging of electric vehicles.

Proposed Guidelines
A set of guidelines has been prepared to provide helpful information to developers with respect to meeting the new regulation in installing the roughed-in EV charging infrastructure. The guidelines provide information on the following:

- acceptable raceway types for connecting an outlet to a breaker
- considerations necessary to ensure there is sufficient electrical supply capacity available for the equipment, and
- design options as, for example, how up to eight parking spaces may share one outlet in a common parking lot and still meet the 3-metre regulation.

Options
Smart Growth Committee may:
(1) Submit this report to Council and continue to recommend to Council that electric vehicle charging infrastructure be required in all new buildings with residential uses, as revised to include this requirement in the Zoning Bylaw and applicable to all building permit applications received 6 months after the date the bylaw amendment is adopted; or
(2) Determine that it wishes to convey a different recommendation to Council; or,
(3) Request staff provide additional information prior to responding to Council’s request.

____________________
Laura Lee Richard, MCIP
Director of Development Services

Attachments:
  2. Draft Guidelines
  3. Updated Technical Appendix
Guidelines for Electric Vehicle (EV) Charging Infrastructure Rough-ins in new construction

**General**

All installations are to be compliant with the BC Electrical Code.

Meters, panels, breakers, conduit and outlets exclusive to EV charging should be labelled ‘EV’ or ‘Electric Vehicle’.

Acceptable raceway types include conduit, open cable trays, or cable.

The building and dwelling unit, as applicable, are to have the minimum electrical capacity for the required EV charging equipment if it was to be connected, in addition to that required for all other building and/or dwelling unit electrical loads, according to requirements of the BC Electrical Code.

**Ground-oriented Buildings with Individual Parking Spaces**

A breaker for EV charging is to be located on the associated dwelling unit’s electrical panel.

Electrical equipment for EV charging is recommended to be sized to deliver a minimum of 32 amps continuously per parking space.

Breakers for EV charging may be shared with other load(s), provided that control equipment is installed to prevent simultaneous operation of EV charging equipment and other load(s).

**Buildings with Common Parking Areas**

Outlets for EV charging may be shared among multiple parking spaces.

A breaker and associated raceway for EV charging may be shared among multiple outlets, assuming that minimum current level requirements are achieved.

Where a breaker and raceway is shared by up to 4 parking spaces, equipment is to be sized to deliver a minimum of 32 amps continuously to the group.

Where a breaker and raceway is shared by 5 or more parking spaces, equipment is to be sized to deliver a minimum of 6 amps continuously per space within the group.

Breakers for EV charging are to be located on one or more electrical panels exclusive to the EV charging.

The separate single utility electrical meter and disconnect are to be connected exclusively to electrical panel(s) containing breakers for EV charging.

Developers of buildings to include stratified ownership of the residential units are encouraged to include guidance on access to, and allotment of costs for EV charging in the initial strata bylaws.
Sample Equipment Configuration for Buildings with Private Parking Areas

- **Breaker**: Installed on unit’s panel
- **Outlet Box**: Installed within 3m of parking space
- **Raceway**: Connecting outlet and panel
Sample Equipment Configuration for Buildings with Common Parking Areas

- Transformer(s) Adequately sized
- Switchboard Adequately sized
- Outlet Box Installed w/in 3m of parking spaces
- Raceway Connecting outlet and panel
- Panel Installed in electrical room
- Breaker Installed on an EV-specific panel
- Meter Installed in electrical room (provided by BC Hydro)
- Disconnect Installed in electrical room
Sample Parking Configurations for Buildings with Common Parking Areas
Electric Vehicles and Charging Infrastructure

Technical Appendix
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EXECUTIVE SUMMARY

Electric vehicles are a growing, low-carbon mode of transportation in British Columbia. Historically, sales have been limited by vehicle range and type, cost, and availability of charging infrastructure. Prices have declined and vehicle range and selection has improved substantially, but access to charging stations has remained a persistent barrier due in large part to the complication of retrofitting residential buildings, where 80%-90% of charging occurs.

Costs of installing EV charging infrastructure can be significantly reduced by pre-installing or “roughing-in” basic electrical equipment at the time of building construction. In ground-oriented structures, this is estimated to cost $80-90 per parking space, while in apartment-style buildings, the cost ranges from approximately $272 to $698 per space – approximately 1/5 the cost of retrofitting after construction. Apartment costs may be offset by $250 to $332 per space when eligible for BC Hydro’s service extension contribution. Roughing-in can also reduce governance barriers in stratified buildings, as it limits the building modification required for final installation of charging stations.

A municipal requirement to rough-in EV infrastructure would not be expected to impact local power delivery infrastructure, would be similar to policies and bylaws adopted in other Lower Mainland communities, and would help contribute to reduced greenhouse gas emissions in Port Coquitlam.

1. STATUS OF ELECTRIC VEHICLES

Currently, 41 models of plug-in electric vehicle (EV) are currently available in Canada. To date, over 7700 electric vehicles have been registered in BC and EVs comprise approximately 4% of passenger car sales in the province (1.2% of all vehicles), approximately 70% of which are located in the lower mainland. Since 2011, annual sales of EVs in BC have seen over 80% year-over-year average growth (see Figure 1).

![Figure 1: EV Registrations and Sales in BC (R.L. Polk & Co. via FleetCarma)](image)

Automakers are increasingly electrifying their fleets, with significant investments being made to bring new electric models to market (see Table 1). Multiple automakers have dedicated to fully electrifying their fleets, including Volvo (by 2019), Jaguar-Land Rover (2020), Opel (2024), Mazda (2030) and GM...
(TBD). Daimler plans to offer electrified versions of all its vehicles by 2022, with Volkswagen following by 2030. Correspondingly, planned lithium-ion EV battery production capacity is set to increase by 520% over 2016 levels by 2020, although Toyota and others are developing ultra-fast charging solid-state batteries aimed to roll out by 2022 or sooner.

<table>
<thead>
<tr>
<th>Make</th>
<th>Planned EV models</th>
<th>Investment (CAD)</th>
<th>Target Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMW</td>
<td>12</td>
<td>$3 billion</td>
<td>2025</td>
</tr>
<tr>
<td>Daimler</td>
<td>10</td>
<td>$14.8 billion</td>
<td>2025</td>
</tr>
<tr>
<td>Ford</td>
<td>13</td>
<td>$5.6 billion</td>
<td>2022</td>
</tr>
<tr>
<td>General Motors</td>
<td>20</td>
<td>Not disclosed</td>
<td>2023</td>
</tr>
<tr>
<td>Honda</td>
<td>2</td>
<td>Not disclosed</td>
<td>2018</td>
</tr>
<tr>
<td>Hyundai</td>
<td>8</td>
<td>$11.8 billion</td>
<td>2022</td>
</tr>
<tr>
<td>Nissan-Renault</td>
<td>12</td>
<td>$14.8 billion</td>
<td>2022</td>
</tr>
<tr>
<td>Tesla</td>
<td>8</td>
<td>Not disclosed</td>
<td>2022</td>
</tr>
<tr>
<td>Volkswagen</td>
<td>80</td>
<td>$35.4 billion</td>
<td>2025</td>
</tr>
</tbody>
</table>

Recent advances in battery technology have resulted in large increases in range, and reductions in the price of EVs (see Figure 2). The new Nissan Leaf, with 240 km range for $36,000, has increased 111% in range and decreased 6% in price since 2011, and new models from Tesla and Chevrolet deliver 350+ km of range for $44,000 or less. These models are oversubscribed in BC and subject to wait times of 6+ months for delivery. Kia and Hyundai are also each releasing a more affordable long-range EV in 2018.

![Figure 2: EV Purchase Price per km of Vehicle Range](image)

The ownership cost of an EV is a factor of purchase, fuel and maintenance costs. Purchase costs currently exceed those of combustion engine vehicles, although these have been rapidly declining, and market research firm Bloomberg expects purchase price parity by 2025 (see Figure 3).
Long-term maintenance costs of electric vehicles cannot be definitively known due to EVs’ relative newness in the marketplace. However, the simpler design of electric motors eliminates the need for engine oil, radiator fluid, and timing belt changes, etc., and investment bank UBS estimates EV maintenance costs at under one-half of those for conventional vehicles. Although premature battery degradation is a concern in EVs, increasingly used thermal management systems can reduce capacity loss to an average 10% or less after 300,000 km. This proportion is expected to decrease as battery technology advances.

Fuel costs for an EV are calculated in kWh (as in utility bills) per 100 km of driving. This efficiency depends on an EV’s design, but today ranges from 12.9 to 24 kWh per 100 km – by comparison, roasting a turkey requires about 8 kWh of electricity. Energy consumed by gasoline vehicles is generally four to five times higher than EVs, and per kilometre fuel costs a similar factor (see Table 2). The Economist projects total unsubsidized lifetime ownership costs of electric vehicles will equal those combustion engine vehicles by 2018.

### Table 2

<table>
<thead>
<tr>
<th>Model</th>
<th>Electric</th>
<th>Gasoline</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Smart Fortwo EV</td>
<td>Tesla Model S P100D</td>
</tr>
<tr>
<td><strong>kWh per 100 km</strong></td>
<td>12.9</td>
<td>24</td>
</tr>
<tr>
<td><strong>Gasoline L/100 km</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Cost per 100 km</strong>*</td>
<td>$1.45</td>
<td>$2.70</td>
</tr>
<tr>
<td><strong>Annual Fuel Cost</strong></td>
<td>$188.85</td>
<td>$351.35</td>
</tr>
</tbody>
</table>

*Estimates electricity cost: 11.26 c/kWh; Fuel cost: $1.30/L; Annual distance: 13,000 km
2. EMISSIONS REDUCTION POTENTIAL

Port Coquitlam has committed to decreasing community greenhouse gas (GHG) emissions by 8% between 2007 and 2017. However, by 2012, the date of the last provincial inventory, vehicle emissions in the city had increased by 22,788 tonnes, or +13.5%. As the community continues to grow, switching away from fossil-fueled vehicles will almost invariably be necessary to achieve any community-level emissions reductions, as over half of community greenhouse gas emissions result from automotive transportation. Given that 97% of power generated in the province is effectively zero-carbon, a switch to even a modest proportion of electric vehicles could substantially ease CO₂ emissions. Using power from BC Hydro, full life-cycle emissions for an electric vehicle would be 80% less than a combustion engine equivalent. Recent research has indicated that all vehicles sales will need to be alternatively-fuelled by 2035 to limit global warming to 1.5 degrees Celsius.

Adoption of EVs in the province has increased at an average rate of over 80% per year since 2011. Projections of EV adoption vary, but range from 24% to 27% (SFU) for the lower mainland, 20%-50% provincially (BC Hydro) and 35% globally (Bloomberg) by 2030. With complementary policies, EV adoption in BC could reach 65.3% by 2040, with models indicating that policies requiring charging infrastructure in homes would contribute to 8% of this uptake. The emissions reductions related to uptake levels by 2030 are shown in Table 3.

Table 3

<table>
<thead>
<tr>
<th>EV share of annual vehicle sales by 2030</th>
<th>1% (baseline)</th>
<th>20%</th>
<th>27%</th>
<th>35%</th>
<th>50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>EV share of all vehicles</td>
<td>0.56%</td>
<td>8.0%</td>
<td>10.9%</td>
<td>14.3%</td>
<td>21.3%</td>
</tr>
<tr>
<td>Emissions from Vehicles (tCO₂e)</td>
<td>208,200</td>
<td>197,500</td>
<td>193,500</td>
<td>188,800</td>
<td>178,800</td>
</tr>
<tr>
<td>Vehicle Emissions Change (tCO₂e)</td>
<td>-</td>
<td>-34,878</td>
<td>-47,085</td>
<td>-61,037</td>
<td>-87,195</td>
</tr>
<tr>
<td>Vehicle Emissions Change (tCO₂e)</td>
<td>-</td>
<td>-5.1%</td>
<td>-7.1%</td>
<td>-9.3%</td>
<td>-14.1%</td>
</tr>
</tbody>
</table>

*Assumes later uptake for heavy vehicles

3. ELECTRIC VEHICLE CHARGING

Unlike combustion engine vehicles, EVs are not normally refueled at external locations. An estimated 80-90% of charging occurs at a driver’s residence, which is more similar to cellular phone charging than fueling at a pump. An EV’s charger is located in the inside the vehicle, converting household power to storable DC (direct current) electricity, while an external charging station delivers the power.

Level 1 charging, which uses a household 120V (15A) plug, is limited to approximately 6 to 11 km of range per hour of charging. It is generally adequate for daily use (the average total commute of a Port Coquitlam resident is 23.6 km), although it may not be sufficient to recharge following longer trips.

Level 2 charging (208 or 240V), uses stove or dryer wiring and can provide range of 20-65 km per hour of charging. It is considered the standard for residential charging, and is also the most common at workplaces and commercial centres.
DC Fast Charging bypasses a vehicle’s internal charger to deliver to supply DC power directly to the battery. This allows for 400+ km of range to be added per hour of charging. However, costs of $15,000 or more per station limits application in most residential settings.

In addition to voltage, current (amperage) also affects charging speed. As current represents the ‘volume’ of electricity delivered, the higher the current, the faster an EV will charge (see Figure 4).
Smart Fortwo EV: Efficiency: 12.9 kWh/100km, Max charge rate: 3.3 kW, Full range: 135 km
Chevrolet Bolt: Efficiency: 17.6 kWh/100km, Max charge rate: 7.2 kW, Full range: 383 km
Tesla Model S P100D: Efficiency: 24 kWh/100km, Max charge rate: 10 kW, Full range: 517 km
Load sharing is the division of electrical current on a common circuit (e.g. a 32-amp divided among 4 stations). Digital control of load sharing, *smart charging*, allows for the redirection of current based on charging requirements, e.g. delivering 8 amps each to 4 charging cars, but 10.7 amps each to 3 cars when one reaches full charge (see Figure 5). As the number of stations on a circuit increases, the average current needed per station decreases, as high demand charging can be offset by larger pool of lower demand charging cars. This lowers the total required amperage (and related infrastructure costs) significantly, and is considered best practice for multi-family buildings. A minimum average 8 amps of current per station is generally recommended for 4 or fewer connections, and 6 amps for 5 or more connections.

**Smart Charging**

![Smart Charging Diagram](image)

*Figure 5: ‘Smart charging’ in 4:1 load shared configuration*
4. COST OF CHARGING INFRASTRUCTURE

The cost of installing Level 2 charging varies dependent on a number of factors. These include: proximity of charging point to electrical supply, the type, number and capacity of charging stations, electrical panel capacity, building type and structural materials, labour rates and assorted materials costs (e.g. wiring, raceway, etc.).

For a ground-oriented dwelling with attached individual parking, overall costs of installing a single Level 2 outlet generally range from $300-1000, plus the cost of the charging station ($500-$1000). However, the need to replace inadequate electrical equipment may add $1500 to $3000 to installation cost. Research by the cities of Richmond and North Vancouver, which includes assessment of unit and building electrical load calculations, transformer and panel sizing, installation of breakers, conduit, outlets, and additional electrical room space, as applicable, has been conducted to determine the costs of roughing-in Level EV charging infrastructure, with similar results. For an average ground-oriented dwelling cost is calculated at $80-$90 per space.

The costs of installing Level 2 charging in multifamily residential buildings vary considerably. A single non-networked station may be comparable in cost to a ground-oriented dwelling, although structural and proximity factors generally result in higher costs, averaging closer to $5000 (minus station). Without pre-installed raceway, coring of concrete and engineering scans are frequently required, raising costs by $1000 or more. Further, the installation of too large a number of uncoordinated stations will draw a disproportionate amount of power, which would require panel and/or power supply upgrading to install additional stations. If there is insufficient transformer capacity, the cost of upgrading it may reach $300,000 or more per building, which can render installation uneconomical.

The cost of bulk retrofitting a building for EV charging after the fact is approximately 5 times the cost of installing during construction, although this factor would be higher if retrofit installations are conducted one at a time, or if other complications arise. The cost of roughing-in EV charging infrastructure in buildings with shared parking areas ranges from $272 to $470 using 6:1 load sharing, or $402 to $698 per space using 4:1 load sharing, depending on building configuration and transformer requirements. A load sharing ratio of 8:1 is technically feasible, but may not be achievable in all parking configurations, so cost estimates of 6:1 load sharing are more likely to be representative of real world costs if 8:1 is permitted.

For developments connecting to a new power supply, which is typical for most new multi-family structures, BC Hydro offers a contribution of up to $200 per kW of projected billing demand. This would equate to a maximum of $250 (6:1) or $332 (4:1) per space towards the extension and could substantially reduce the cost of EV charging installation.

5. OTHER CONSIDERATIONS

Strata Governance

Multi-unit residential buildings are often managed by strata corporations or property management firms, which can represent a challenge to the installation of EV charging. Structural modifications to retrofit existing buildings for EV charging would be considered a significant change to common property, and would therefore require a ¾ vote in condominiums, a barrier which in many buildings may be more challenging than costs. Pre-installed infrastructure would limit the level of building modification, and generally eliminate the need for a vote in order to
add stations. BC Hydro is currently funding the development of a strata bylaw template to address the right to charge and cost allocation, which will be distributed to the developers.

Cost allocation
The ability to fairly allocate costs for EV charging can be a concern in multi-family settings. Although sale of electricity is restricted in BC, employers and landlords and are permitted to resell electricity to employees or tenants, as applicable, with strata organizations considered equivalent to landlords. A common approach is a flat fee for use of chargers to cover costs to a common electric account. However, networked charging systems, which are becoming standard in multi-unit buildings, allow tracking of actual user electrical use, and prevent unauthorized use of charging stations. BC Hydro also allows installation of a second power meter for EV charging, which provides for power costs to be allocated collectively in the absence of, or in conjunction with networked solutions. This allows power for EV charging to be billed separately, and not contribute to higher rate steps or demand charges for a building’s general common hydro account. Roughing-in can help equalize initial costs by preventing disproportionate expense to the first installer of EV infrastructure that is likely to be shared by later users.

Outlet location
An additional consideration is the placement of charging outlets, as parking spaces are often assigned to a unit before sale, and it is unknown which buyers may need EV charging. Requiring one roughed–in space per dwelling unit increases the probability that all future owners will have the option to access EV charging. Costs can be reduced through the use of load sharing via one outlet shared among multiple parking spaces (e.g. up to 8 spaces), which would allow access for each. Additionally, multiple outlets can share raceway to reduce infrastructure requirements (see Figure 6).
Upstream Power Supply
BC Hydro has included EV power use in its electrical load forecasting since the mid-2000s and incorporates this into its infrastructure planning. Recent upgrades have been completed to the Como Lake Substation to increase local power delivery in light of projected demand changes. EV charging is not expected to challenge infrastructure capacity in the near term, as EV uptake is projected to increase progressively through vehicle turnover. Additionally, load management is expected to limit power demand increase, and associated infrastructure upgrades.

Technological Change
Another consideration for future EV charging is the role of changing technology and how this may alter requirements in infrastructure. Although it is not possible to exactly predict how technology will evolve, it is assumed that networked charging will become more sophisticated, battery capacity will improve, charging capacity will increase, and vehicles will become less expensive and more efficient. Regardless, the use of EVs will still require the delivery of sufficient power, and barring dramatic changes in driving patterns, this need will generally be met with 16A Level 2 charging; or 6- to 8A using load sharing technology.
6. OTHER MUNICIPAL POLICIES AND REGULATIONS

City of Richmond

The City of Richmond is currently considering the requirement for full wiring for Level 2 charging in 100% of residential parking spaces. This would replace current Official Community Plan requirements for 20% of residential parking stalls to be provided with a wired Level 1 receptacle, and that an additional 25% be roughed-in for Level 1 charging.

City of North Vancouver

City of North Vancouver rezoning guidelines require 20% of residential parking spaces to be wired for Level 2 (40A) charging, and that the remaining 80% of spaces have rough-ins, for the future installation of charging stations.

District of West Vancouver

The District of West Vancouver maintains a policy requiring all new multi-family developments to provide an appropriate number of dedicated EV plug-in outlets (generally determined to be one for each unit), and new commercial developments over 1500 m² in floor area to provide for an expansion of the public electric vehicle charging network.

City of Vancouver

The City of Vancouver building bylaw currently requires all new one- and two-family homes to be wired for Level 2 (40A) charging. Twenty percent of parking spaces in multi-family or the multi-family component of a mixed-use building must be Level 2 wired, with sufficient space in the electrical room for expansion to all wire spaces to Level 2. These were originally enacted in 2010. The requirement for ten percent of parking spaces in commercial, or the commercial component of a mixed-use buildings to be Level 2 wired was later added.

District of North Vancouver

The District of North Vancouver administrative and operational policy since 2014 has required 20% of residential parking stalls wired for Level 1 charging, with the remaining 80% of spaces rough-in for Level 1. Approximately 10% of commercial and industrial parking spaces must be wired for Level 2 charging (dependent on location).

City of Burnaby

The City of Burnaby through its rezoning process negotiates a target 10% of residential parking spaces to be equipped with wired Level 2 charging stations in mixed use and multi-family developments. It is currently exploring an expanded formal requirement.

Corporation of Delta

Currently, the Corporation of Delta is revising its zoning bylaw to potentially require Level 2 wiring of parking spaces in residential or mixed use buildings.

City of Port Moody

The City of Port Moody is considering a zoning bylaw amendment to require ten percent of residential off-street parking at least one of the visitor space to include electrical infrastructure
and space allocation to accommodate electric vehicle supply equipment in multi-residential uses with three or more units.

**Other Municipalities**

The cities of Langley, Surrey, Coquitlam and Maple Ridge are currently in the process of developing proposals to require EV charging infrastructure in residential buildings.

### 7. RELEVANT LEGISLATION AND PROGRAMS

#### BC Building Act

The Building Act excludes electric vehicle charging infrastructure from being restricted by the Building Code. This allows for municipal governments to regulate, via bylaw, electric vehicle charging stations, including the number, location, and type of charging stations (and related matters such as signage) and any wiring or pre-ducting required in a building or facility to charge electric vehicles that use the building for parking. Building energy intensity calculation guidelines for the BC Energy Step Code specifically exclude energy used for EV charging.

#### BC Strata Property Act

The Strata Property Act (SPA) governs the responsibilities and requirements of Strata corporations in the province. Although there is no specific language regarding EV charging in, Section 258 of the law does define rules for parking allocations (e.g. Common property v. Limited Common Property v. Strata lot, exclusive rights use, etc.). These are relevant in cases where not all parking spaces have access to EV charging.

Section 71 (a) of the SPA requires a three-quarter vote at a general meeting before making “a significant change in the use or appearance of common property”. Installation of a charging station would change the appearance of the common property and may be viewed by some as changing the appearance “significantly”. Correspondingly, infrastructure installed prior to initial sales require no such strata approvals.

Section 128 of the SPA requires a three-quarter vote at a general meeting for a bylaw that levies a reasonable user fee (e.g. for EV charging). In the absence of a bylaw for a new user fee, under section 125(6) a strata council may make a rule for the fee but that rule would lapse unless approved by a majority vote of owners at the subsequent general meeting.

#### BC Hydro

BC Hydro charges a fee to extend electrical service in new developments, which includes initial power supply connection for the majority of new multi-family buildings. However, BC Hydro will also contribute to the costs based on the projected power demand associated with the extension. Multi-family buildings may be eligible for a contribution of up to $200 per kilowatt of projected future demand, including that for electric vehicle charging.

#### BC Utilities Commission Act

Section 3 of the Act allows only ‘eligible persons’ as approved by the commissioner, to generate, produce, transmit, distribute or sell electricity, contingent upon the execution of an energy supply contract. However, Landlords and employers providing electricity to tenants/employees may resell, and strata members are generally considered equivalent to tenants.
BC Electrical Code
The BC Electrical Code is based on the Canadian Electrical Code, and covers all electrical system installation and modification in the province. Section 6 governs load management systems, and section 86 governs electrical vehicle charging equipment. Both these sections are set to be updated in late 2017 in light of technological changes to provide better guidance for load management in EV charging.

BC Motor Vehicles Act
Section 42 of the Motor Vehicles Regulations regulates the use of High Occupancy Vehicle (HOV) lanes in the province, which prevents vehicles with less than two occupants from using HOV lanes. As of March 2016, electric vehicles are excluded from these occupancy requirements, and can use HOV lanes at all times.

Metro Vancouver Transportation Programs
Metro Vancouver actively promotes the use of electric vehicles on its own website and Emotivebc.ca, and the establishment of EV charging infrastructure in multi-family residential settings at EVCondo.ca. The latter provides guidance to EV owners, strata councils and property managers through the process, including sample strata bylaws, electrician contact information, common challenges and solutions, and a list of EV-friendly strata buildings.

BC Clean Energy Vehicle Program
The BC Clean Energy Vehicle for BC Point of Sale Incentive Program (CEVforBC) is a provincial government program that incents the purchase of new battery-only electric, plug-in hybrid, and extended range electric vehicles (i.e. battery driven with gasoline-powered generator). Incentives range from $2,500 to $5,000 depending on vehicle type, applied to pre-tax sale price. The program expires when funding is exhausted (44% has to date been disbursed).

Scrap-it program
The Scrap-it program is a not-for-profit program that will reimburse up to $6,000 for the purchase of an electric vehicle, contingent upon the scrapping of an older combustion engine vehicle. Both new and used electric vehicles are eligible, and the program is funded by scrap vehicle revenue, commercial contributors and some government grants. There is no set expiry for the program, but it is subject to change at any time.