

Electric Vehicle Charging for Buildings

The intent of this bulletin is to provide an update with respect to the amendments and new requirements of Electric Vehicle (EV) Charging in the Vancouver Building By-law (VBBL) and Parking By-law. This bulletin supersedes Bulletin 2016-006-BU/EL.

Effective January 1, 2019, all residential parking spaces for new multiple dwellings, multiple dwelling components of multiple-use developments, and rowhouses, excluding visitor parking spaces, shall be provided with an energized electrical outlet capable of providing Level 2 EV charging or higher to the parking space. These requirements apply to new Development Permit Applications submitted on or after January 1, 2019.

These requirements will not be triggered by a change of use to the non-residential portion of a mixed-use project, unless additional residential units are added to building space that was previously another use.

The requirements of EV Charging for commercial buildings with commercial parking stalls, and for one-family dwellings, two-family dwellings, and ancillary residential units with garages or carports have been removed from the VBBL. New requirements of EV Charging for required parking spaces are now included in section 4.14.1 of the Parking By-law.

The Electric Vehicle Energy Management System (EVEMS), Electric Vehicle Supply Equipment (EVSE) and other associated electrical equipment must be approved, and installed in conformance with the Canadian Electrical Code, Part I (CE Code).

For the purpose of Sentence 10.3.1.1. (3) of the VBBL, where the EVEMS is implemented, a minimum performance level of 12 kWh per EVSE over an eight (8) hour overnight period, controlled by the EVEMS must be achieved, assuming all parking spaces are in use by a charging EV.

The proposed installation of EVEMS, EVSE, methods for power allocation to EVSE, energy management configurations and control schemes may be reviewed and accepted on a case-by-case basis through the Development, Buildings and Licensing under the VBBL and Electrical By-law (VEBL).

For details of the EV charging requirements and clarifications, please refer to the **APPENDIX** of this bulletin.

The City of Vancouver has coordinated with the City of Richmond's efforts in developing strata rule/bylaw content for owner-developer's and stratas' consideration to support management of EV charging. This guidance was published in October 2018, and is provided at the link below.

https://richmond.ca/shared/assets/EV_Charging_in_Shared_Parking_Areas_Report51731.pdf

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APPENDIX

1. Background

The market share of plug-in EVs is growing rapidly, and this growth is projected to continue. EVs generally offer lower operating costs than comparable internal combustion (gasoline/diesel) vehicles, and the costs to purchase EVs are decreasing. EVs also emit near-zero greenhouse gas emissions and air pollutants when powered from BC's electrical grid.

The City of Vancouver began requiring EV infrastructure in buildings in 2011. At the time, the City was able to use the VBBL to introduce these new EV charging requirements. In 2016, the Province of BC amended the Building Act, which allowed other local governments to create requirements relating to EV charging under zoning laws.

In 2016, City Council approved the EV Ecosystem Strategy, which is one component of the City's long-term commitment to 100% renewable transportation by 2050.

The EV Ecosystem Strategy seeks to, among other things, increase access to home charging infrastructure. Whether households have access to an electrical connection for home charging in a dedicated parking stall is a key determinant of whether they will choose to drive an EV.

Action H1 of the EV Ecosystem Strategy commits to:

“Expand building requirements for EV charging readiness in MURBs such that each resident has access to EV charging in their own parking stall.”

The 2016 strategy also commits to a *Flexible Requirements Quick Start* which would:

“Move development-specific elements of EV charging requirements (e.g., number of stalls equipped) to the Parking By-law.”

The rationale for the Quick Start is that the VBBL does not consider a building's use under zoning, and therefore is more challenging to use when considering how EV infrastructure requirements are applied. The VBBL is more appropriate when considering life safety. Conversely, the Parking By-law is closely tied to the City's zoning system, and can therefore allow for more flexible, use-specific applications.

In March 2018, City Council approved changes to the VBBL and Parking By-law to require that multi-family buildings provide EV infrastructure in 100 per cent of residential parking spaces (excluding visitor spaces), and to meet the requirements of the Flexible Requirements Quick Start.

2. Vancouver's Electric Vehicle (EV) Charging Infrastructure Requirements

To support access to EV charging for buildings, City Council approved amendments to the VBBL, Parking By-law and VEBL. These amendments and new requirements are:

a) VBBL - Subsection 10.3.1. Electric Vehicle Charging for Buildings
Article 10.3.1.1. Electrical Service and Capacity

- 1) The electrical installations, including the service capacity of the installation, the number and distribution of circuits and receptacles, shall meet the requirements of the “Electrical Safety Regulation.”

- 2) Where the requirements of section 4.14.1(a) of the Parking By-Law would cause the dwelling unit's calculated load to exceed 200 A in buildings containing not more than 2 primary dwelling units, with or without ancillary residential suites, the installation of an energized outlet for Level 2 charging may be omitted provided that a minimum nominal trade size of 21 raceway supplied with pull string leading from the dwelling unit panelboard to an electrical outlet box is installed in the storage garage or carport and is labelled to identify its intended use with the electric vehicle supply equipment.
- 3) Where an electric vehicle energy management system is implemented, Chief Building Official may specify a minimum performance standard to ensure a sufficient rate of electric vehicle charging.

b) Parking By-law - 4.14 Required Parking Spaces of Electric Vehicle Charging

4.14.1 For each:

- (a) one-family dwelling, two-family dwelling, one family or two family dwelling with a secondary suite or lock off unit, rowhouse and laneway house, each storage garage or carport shall be provided with an energized outlet capable of providing Level 2 charging or higher to the storage garage or carport, except where the provisions of Sentence 10.3.1.1.(2) of Division B of Building By-law apply;
- (b) multiple dwelling, multiple dwelling component of a multiple-use development, or rowhouse, all parking spaces provided for residential use, excluding visitor parking spaces, shall be provided with an energized outlet capable of providing Level 2 charging or higher to the parking space;
- (c) commercial building or commercial component of a multiple-use development with ten or more parking spaces, a minimum of one parking space for every ten parking spaces, plus one space for any additional parking spaces that number less than ten, shall be provided with an energized outlet capable of providing Level 2 charging or higher to the parking space; and
- (d) commercial building or commercial component of a multiple-use development with less than ten parking spaces, a minimum of one parking space shall be provided with an energized outlet capable of providing Level 2 charging or higher to the parking space.

4.14.2 Energized outlets provided pursuant to section 4.14.1 above shall be labeled for their intended use for electric vehicle charging and installed in conformance with Sentence 10.3.1.1.(1) of Division B of the Building By-law.

Note that a previous version of the VBBL included EV charging infrastructure in Subsection 10.4.3. References to Subsection 10.4.3 relating to EV charging infrastructure should be redirected to Subsection 10.3.1 of the VBBL.

c) VEBL - 7.3.7 Electric Vehicle Charging

Where required by the Building By-law, an owner shall comply with the electrical requirements governing Electric Vehicle Charging in Part 10 of that By-law.

2.1. Terminology

Electric Vehicle means a vehicle that uses electricity for propulsion, and that can use an external source of electricity to charge the vehicle's batteries. (Parking By-law Section 2)

Electric vehicle - an automotive-type vehicle for use on public roads that

- a) includes automobiles, buses, trucks, vans, low-speed vehicles, motorcycles, and similar vehicles powered by one or more electric motors that draw current from a fuel cell, photovoltaic array, rechargeable energy storage system (such as a battery or capacitor), or other source of electric current;
- b) includes plug-in hybrid electric vehicles (PHEVs); and
- c) excludes off-road electric vehicles, such as industrial trucks, hoists, lifts, transports, golf carts, airline ground support equipment, tractors, and mobility scooters for persons with disabilities. (CE Code Section 86)

Electric Vehicle Supply Equipment (EVSE) means a complete assembly consisting of cables, connectors, devices, apparatus, and fittings installed for the purpose of power transfer and information exchange between the branch circuit and the electric vehicle. (Parking By-law Section 2 and CE Code Section 86)

Electric vehicle energy management system - a means used to control electric vehicle supply equipment loads through the process of connecting, disconnecting, increasing, or reducing electric power to the loads and consisting of any of the following: a monitor(s), communications equipment, a controller(s), a timer(s), and other applicable device(s). (CE Code Section 8)

Energized Outlet means a connected point in an electrical wiring installation at which current is taken and a source of voltage is connected to supply utilization equipment. (Parking By-law Section 2)

Level 2 Charging means a Level 2 electric vehicle charging level as defined by SAE International's J1772 standard. (Parking By-law Section 2)

Level 2 charging defined by SAE International's J1772 standard is shown in the table below

Charge Method	Nominal Supply Voltage (V)	Max Current (Amps-continuous)
AC Level 2	208 to 240 VAC, 1 phase	<= 80A

2.2. Each storage garage and carport serving building of one-family dwelling, two-family dwelling, one family or two family dwelling with a secondary suite or lock off unit, rowhouse, laneway house and infill dwelling

The parking spaces in a garage and carport serving buildings of residential occupancies as described in Parking By-law section 4.14.1 (a) must be provided with an energized outlet capable of providing Level 2 charging or higher. Below are three strategies which may be utilized to meet the City's requirement.

- 1) Installation of an electrical outlet, a receptacle or an EVSE, supplied by a separate branch circuit that supplies no other loads except ventilation equipment intended for use with the EVSE. In the case of any circumstance where the City Electrician considers it necessary or desirable; installation of a complete run of EVSE-Ready raceway system (minimum trade size 21 equipped with pull string) connected between the service panelboard (with sufficient spaces left for future overcurrent devices) and an outlet box at the parking space. Equipment to be marked and labelled as per the CE Code and section 4.14.2 of Parking By-law, and VBBL. The following circuit ratings are considered to be acceptable for Level 2 charging.

2-pole circuit breaker	Size, AWG copper conductors (Table 2 CE Code)	Type of Level 2 charging station	Separate disconnecting means (Rule 86-304)
20 A	12	208/240 V - 16 A	NA
40 A	8	208/240 V - 32 A	NA
50 A	6	208/240 V - 40 A	NA
90 A	2	208/240 V - 70 A	Required
100 A	2	208/240 V - 80 A	Required

- 2) Installation of an electrical outlet, a receptacle or an EVSE, controlled by a load management system supplied by a branch circuit for use with the EVSE load and other load. It is important to note that EVSE provided with a switch could frequently disconnect and reconnect the source of power supply. This in turn could affect the performance of some models of EVSE. The equipment manufacturer's instructions should be consulted.
- 3) Installation of an EVSE controlled by an EVEMS - to monitor the electrical load of consumer's service, feeder or panelboard, and to control the EVSE load.

It should be noted that equivalent changes to requirements for the amount of EV infrastructure in one- and two-family homes, etc., have not yet been incorporated into the Parking By-law. However, as indicated in the 2016 EV Ecosystem Strategy, it is the City's intent to ensure 100% EV-readiness in all new residential parking stalls, excluding visitor stalls.

In addition, it is the City's intent, as laid out in the 2016 EV Ecosystem Strategy's *Panel Exemption Quick Start* to "Remove 200A calculated load exemption for new construction of one- and two-family homes under the Vancouver Building By-law". These changes are expected to be introduced in a future update to the Parking By-law and VBBL, expected in 2020.

2.3. All parking spaces provided for residential use serving building of multiple dwelling, multiple dwelling component of a multiple-use development, and rowhouse

For the purpose of section 4.14.1 (b) of the Parking By-law, each residential parking space, excluding the visitor parking spaces, must be provided with an energized outlet capable of providing Level 2 charging or higher. Below are three strategies which may be utilized to meet the City's requirement.

1. Installation of an electrical outlet, a receptacle or an EVSE, supplied by a separate branch circuit that supplies no other loads except ventilation equipment intended for use with the EVSE. Equipment to be marked and labelled as per the CE Code and section 4.14.2 of Parking By-law. For circuit ratings acceptable for Level 2 charging, please see above Table in item 2.2. 1).
2. Installation of an EVSE controlled by an EVEMS, or a networked EVSE with load management or load sharing capabilities; compatible with the other networked/interconnected EVSE. A minimum performance level of 12 kWh per EVSE over an eight (8) hour overnight period, controlled by the EVEMS must be achieved, assuming all parking spaces are in use by a charging EV.
3. Installation of an EVSE-Ready outlet intended for connection of an EVSE supplied by an EVEMS-Ready circuit, or a Networked EVSE-Ready circuit. The application for a permit for proposed installation of such EVSE-Ready electrical outlets and circuits must be accompanied by the followings:
 - a) Plans and specifications.
 - b) Load calculations in accordance with the CE Code.
 - c) All loads designed to be managed by EVEMS to be identified and included in load calculations.
 - d) EV charging infrastructure configurations (load management, sharing and control schemes).
 - e) Proposed performance standard for EV Charging (EVEMS) in accordance with the VBBL.

Note: In lieu of Level 2 charging requirements of the Parking By-law, the City may accept installation of Direct Current Fast Charging (DCFC) to meet or exceed the minimum VBBL or Parking By-law requirements in multiple-dwelling buildings. The City would require that such installations achieve the equivalent level of performance to that required under the VBBL and Parking By-law. That is, that DCFC provides adequate, daily

charging for all parking spaces required to be provided with EV charging. The City may require a covenant or other legal guarantee to ensure that the needs of residents will be met over the long term.

2.4. The minimum performance standard for EV Charging where an EVEMS is implemented

For the purpose of Sentence 10.3.1.1.(3) of the VBBL, where an EVEMS is implemented, a minimum performance level of 12 kWh per EVSE controlled by EVEMS or per networked/interconnected EVSE with load management or load sharing capabilities, over an eight (8) hour overnight period must be achieved, assuming all parking spaces are in use by a charging EV.

Note: EVEMS also referred to as load sharing, power sharing, or smart charging, refer to a variety of technologies, including service provision, that allow multiple vehicles to charge on the same circuit. Some manufacturers have developed EVSE hardware and software that allow multiple EVSE ports to be managed on circuits which capacity is less than the EVSE nameplate ratings. This hardware and software will dramatically lower installation costs in some cases, and allow existing electrical capacity to serve many more vehicles in other cases, promoting more widespread and rapid adoption of electric vehicles. These are some of the typical algorithms employed for charging: sharing, taking turns, round robin, first come first served, or managed by other parameters such as priority, departure time, cost or other factors, determined by customizable administrative rules. For more details regarding EV Charging, please see this report https://richmond.ca/shared/assets/EV_Charging_in_Shared_Parking_Areas_Report51731.pdf

2.5. Meeting the requirements for non-residential buildings with parking spaces

The three strategies provided in item 2.3 above may be utilized to meet the requirement of Parking By-law section 4.14.1(c)(d).

3. Electrical permits and installation of EVEMS and EVSE

3.1 CSA C22.1-18 CE Code, Part I: Circuit loading & demand factors, & EV charging systems

The new Rule 8-500 added in 2018 CE Code permits installation of EVEMS; this Rule permits EVEMS to monitor electrical loads and to control electric vehicle supply equipment (EVSE) loads, and also permits EVEMS to control electrical power by remote means. An EVEMS must not cause the load of a branch circuit, feeder, or service to exceed the requirements of Rule 8-104 5) or 6).

Rule 86-300 1) requires EVSE to be supplied by a separate branch circuit. A new Rule 86-300 2) is added in 2018 CE Code to permit EVSE to be supplied from a branch circuit supplying other loads provided that an EVEMS is installed (from the simplest manual load transfer type to the automated type).

In conformance with the new Rule 8-106 10) and 11), when EVSE is controlled by EVEMS, the demand load for the EVSE shall be equal to the maximum load allowed by the EVEMS, where the EVEMS monitors the consumer's service and feeders and controls the EVSE loads in accordance with Rule 8-500, the demand load for the EVSE shall not be required to be included in the calculated load.

EVSE loads are permitted to be added with a demand factors as specified in the new Table 38 added in 2018 CE Code; with the application of Rules 8-202 to 8-210.

3.2 EVEMS/EVSE load added to an existing building's service

The calculated load for service or feeder must meet the applicable requirements of Section 8.

Review a simple [electrical load calculation](#) template for the [application of Rule 8-200](#).

When adding EVSE loads to an existing service (or feeder); these additional loads must be calculated in accordance with Section 8. However, where it is impracticable to calculate the existing loads, accurate information on the existing loads taken over the most recent 12-month period can be used to verify that the ampere rating of the existing service (or feeder) will be sufficient to accommodate the newly added loads in accordance with Rule 8-106 8).

For the purpose of Rule 8-106 8) in determining the maximum demand load of existing installation, the peak demand calculation should be based on the following formula:

Maximum amps = (Peak demand ampacity obtained from BC Hydro valued in an hourly interval kWh X 125% demand factor based on load diversity) X 1000 / 240V

Question: The existing service is 100 A, 10.5 kWh historical peak demand has been obtained from BC Hydro, is the rating of existing service sufficient to accommodate the existing and newly added Level 2 (32A) EVSE loads?

Peak demand kWh = 10.5 kWh X 1.25 = 13.125

Maximum amps on existing installation = 13.125 X 1000 / 240 = 54.687A

Maximum amps on newly added EVSE load = 32A

Minimum ampacity of service = 55 + 32 = 87A

Answer: Yes. Peak Demand Ampacity + EVSE's nameplate ampacity ≤ rating of existing service.

3.3 Use of approved electrical equipment and marking of electrical equipment

Electrical equipment used in electrical installation covered by electrical permit must be approved in conformance with CE Code Rule 2-024. Approved means that electrical equipment installed under provisions of CE Code is required to be certified by a certification organization accredited by the Standards Council of Canada in accordance with requirements of the applicable safety standards for electrical equipment as listed in Appendix A.

Rule 8-500 permits installation of EVEMS; this Rule permits EVEMS to monitor electrical loads and to control EVSE loads, and also permits EVEMS to control electrical power by remote means.

Although 2018 CE Code, Part I recognizes the advanced EVEMS technologies, but CSA CE Code, Part II standard or other safety standard is currently absent in Canada; i.e. no safety standard to specify design, construction, performance, functional and marking requirements for the EVEMS, EVEMS controls EVSE, and EVEMS controls electrical power by remote means. If there is no safety standard available for the EVEMS, this equipment could be made approved by means of a Special Inspection to the CSA Model Code SPE-1000 for the Field Evaluation of Electrical Equipment.

For the purpose to ensure safe and proper operation of the equipment, and to provide information necessary for the installation, servicing, maintenance, testing, repair, replacement, and evaluation of the electrical equipment; marking of the equipment (EVEMS and associated equipment) must be provided in conformance with CE Code Rule 2-100. Marking (caution label) of the maximum continuous load (amperes) is required to be field applied adjacent to the fused switch or circuit breaker nameplate to indicate the maximum continuous loading permitted for connection to the fused switch or circuit breaker. This provides important

and valuable safety information for owners, installer and inspectors should an alteration or modification to the electrical system be considered in the future.

3.4 Receptacles for EVSE controlled by EVEMS or networked EVSE system

Installation of receptacles for EVSE controlled by EVEMS, or networked EVSE; such as a CSA configuration 6-50R may leave the system vulnerable to alterations by unqualified persons. The power supply conductors are required to be direct-connected (hard-wired) to the EVSE (EVSE not be cord-connected by means of a cord and attachment plug).

3.5 Annual permits. Review [Bulletin 2019-003-EL](#).

Maintenance and operation of EVEMS require annual permits. Some EVEMS allow an administrator to manage, monitor, and control loads. These systems require the administrator to play an important role in the safe management of the loads on the distribution equipment, feeders, and services. When the need for an administrator is identified in the manufacturer's instructions or plans and specifications, and to ensure and monitor the installed and configured EVEMS and associated EVSE are maintained and operated safely, an annual permit is required. The application for an annual permit shall be accompanied by a management plan, which must document how the EVEMS will control the connected loads and how the addition, alteration, or removal of loads will be managed.

The following are the responsibilities of an annual permit holder and the FSR named on the permit:

- a) All EVSE and EVEMS, plans and specifications including load calculations in accordance with the CE Code must be identified in the annual permit log.
- b) All alterations and modifications to the EVSE or EVEMS equipment, including changes to operation of the equipment must be recorded in the annual permit log. Only qualified and authorized persons or manufacturer's representatives are permitted to configure EVEMS.
- c) The permit holder, equipment owner, administrator, and operators must be provided with the necessary training to operate the system in a safe manner. Such training must be documented and be made available to the City, upon request.
- d) The permit holder must be responsible to maintain a management plan that controls the loads on the electrical system, including the demand loads on the system.
- e) Original documentation including installation and maintenance instructions, plans and specifications, commissioning reports and other documentation associated with the EVEMS, and EVSE must be obtained from the responsible installer or equipment owner.
- f) The equipment owner must appoint an administrator or an authorized agent of the administrator to be responsible for operating the EVEMS if required by EVEMS.

3.6 Installation permits. Review [Bulletin 2001-008-BU/EL](#).

- a) Plans and specifications including load calculations in accordance with the CE Code must be accompanied with all permit applications.
- b) All loads being managed by the EVEMS shall be identified and included in load calculations.
- c) The connected load shall be determined by the nameplate markings on the EVEMS.
- d) EVSE with variable load settings shall have the maximum setting permanently marked on the equipment.
- e) For third party EVEMS, documentation on the suitability of the system with the EVSE to be submitted to the City's electrical inspector prior to final inspection.

- f) A copy of SPE-1000 Special Inspection Report to be submitted to the City's electrical inspector prior to final inspection.
- g) A copy of the accepted plans and specifications, manufacturer's instructions, and commissioning reports and other documentation associated with the EVEMS, and EVSE must be provided to the equipment owner prior to allowing the equipment to be placed into operation, and prior to final inspection.

3.7 Conditions of permits

- a) In the event of a breakdown or malfunction of the EVEMS, EVSE communications or EV response, the EVSE must disconnect power to the EV. The EVSE must establish a fail-safe condition if there is a loss of communications between the EVEMS and the EVSE if the EV does not respond appropriately or when it is evident that automatic restarting or the lack of communications is liable to create a hazard. Once safe operating conditions are restored a safe start-up of the EVSE must be ensured.
- b) EVEMS must not cause the load of a branch circuit, feeder or service to exceed the rating of the circuit.
- c) EVEMS must not adversely affect operation of the life safety systems, essential electrical systems and emergency electrical power supply systems as defined or referenced in the CE Code.
- d) The failsafe processes installed in the energy management system must remain in effect for the life of this equipment and must not be altered in any way.
- e) BC Hydro must be consulted and notified of all EVEMS installations where the service may be overloaded upon the failure or removal of the EVEMS.

3.8 The noteworthy details

Sentence 10.3.1.1.(3) of the VBBL requires a minimum performance level of 12 kWh per EVSE, over an eight (8) hour overnight period where an EVEMS is implemented. The average distance driven per day in Vancouver is about 45km, the 65km allowance is considered appropriate for purpose of the VBBL. Table below are the method and examples for calculating the maximum power obtainable from the EVSE by an EV.

<p>Maximum km for 4-shared EVSE with load management or load sharing capabilities (power transfer = power required)</p> <p>Maximum Power Transfer (kWh/EV) = Volts (circuit) x Amps (circuit) x derating x efficiency / 1000 / number EV's on shared circuit</p> <p>Maximum Power Out = Maximum Distance (km) x Energy Consumption rate (kWh/km)</p> <p>Maximum Distance = Maximum Power Out / Energy Consumption rate (kWh/km)</p> <p>Maximum Power Transfer (kWh/EV) = 208 x 40 x 0.8 x 0.95 x 8 / 1000 / 4 = 12.65 kWh</p> <p>Maximum Distance = 12.65 (kWh) / 0.185 (kWh/km) = 68.35 km</p> <p>CONCLUSIONS - The Level 2 configurations, with sharing of up to 4 EVSE on a 40A 208V circuit, or equivalent (additional EVSE on a circuit of greater ampacity), achieve the minimum performance level.</p>

Examples for calculating maximum power obtainable from the EVSE by an EV; over an eight (8) hour period

1. For a standalone Level 2 EVSE - 20A 208V
 $208 \times 20 \times 0.8 \times 0.95 \times 8 / 1000 = 25.29 \text{ kWh Maximum Power Transfer}$
2. For a standalone Level 2 EVSE - 40A 208V
 $208 \times 40 \times 0.8 \times 0.95 \times 8 / 1000 = 50.58 \text{ kWh Maximum Power Transfer}$

3. Level 2 configuration with EVEMS - based on allocating equal power across 2 EVSE on a 20A circuit
 $208 \times 20 \times 0.8 \times 0.95 \times 8 / 1000 / 2 = 12.65$ kWh Maximum Power Transfer per EV
4. Level 2 configuration with EVEMS - based on allocating equal power across 2 EVSE on a 40A circuit
 $208 \times 40 \times 0.8 \times 0.95 \times 8 / 1000 / 2 = 25.29$ kWh Maximum Power Transfer per EV
5. Level 2 configuration with EVEMS - based on sharing of up to 4 EVSE on a 40A circuit
 $208 \times 40 \times 0.8 \times 0.95 \times 8 / 1000 / 4 = 12.65$ kWh Maximum Power Transfer per EV

While the EVEMS technologies are in relative infancy, there are viable commercial products currently available and many installations have already been accepted by the City. There are a variety of energy management configurations and control schemes. With software controlling electrical loading on circuits and panels, safety is an important issue. Appropriate fail-safe mechanisms, configuration, testing and commissioning, and management procedures are required to ensure systems function correctly, and that in the event of error or failure, impacts are minimized and do not present a safety hazard.

The installation, maintenance, operation, configuration and management of EVEMS must be performed by qualified persons under electrical installation and annual permits in conformance with the VEBL.