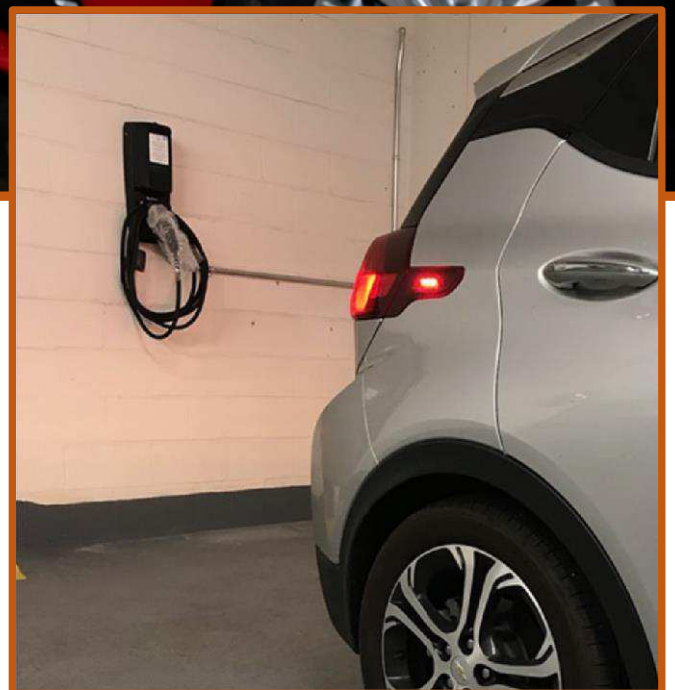


Electric Vehicle Charging Guide



Welcome to the Cielo Electric Vehicle Charging Guide. This guide will provide a basic overview electric vehicle charging, different types of charging technology with a focus on charging for residential and multi residential applications. Please note that DC Fast Charging, Tesla Supercharging and Conductive Charging options will not be covered in this guide, however if you require further information on these types of charging, please let our team know and we would be happy to provide this information.

Charging Options

All charging options mentioned in this guide comply with the SAE J1772 standard. Electric Vehicles sold in North America comply with the SAE J1772 standard which defines a standard connector and communications protocol for AC charging of electric vehicles. The J1772 standard ensures that a vehicle is aware of the limitations of the circuit it is connected to, ensures that power is only applied when the vehicle is actively requesting power (preventing bad connections, arcing and potential fire risks), and prevents the vehicle from being driven while a charging cable is still attached. A J1772-compliant charging station essentially acts as an extension cord with these safety features built-in.

Level 1 Charging

Level 1 charging is the slowest form of charging, although it is quite versatile due to the ubiquity of 120V outlets. The Canadian Electrical Code requires a dedicated 120V 20A circuit for Electric Vehicle Charging.

Level 2 Charging

Level 2 charging is the most common type of public charging infrastructure in British Columbia, with over 1,900 Level 2 charging ports active. The charging rate is typically more than doubled as compared to Level 1 charging, due to a higher voltage (208V or 240V vs 120V) and higher amperage circuits (40A being the most common, vs 20A circuits for Level 1). The J1772 standard supports Level 2 charging rates between 12-80A. The actual charging rate will depend on the minimum of either the Electric Vehicles maximum charging rate or the charging stations available power. Many Electric Vehicles now support Level 2 charging at 30A (example Nissan Leaf, Ford Focus EV).

Charging Times

Charging Level	Circuit Rating	Vehicles Supported	Charging time required for 30km of range (~6kWh)*	Charging time required for 120km of range (~24kWh)*
AC Level 1 (1.4kW-1.9kW)	120V, 20A	All EVs	4h	16h
AC Level 2 (3.3-3.6kW)	208V, 16A	All EVs	2h	8h
AC Level 2 (6.6-7.2kW)	208V, 40A	Most new EVs	1h	4h
AC Level 2 (19.2kW)	208V, 100A	Tesla Model S & X	<0.5h	<1.5h

**Derived from energy output of applicable circuits.*

Networked Stations

Networked stations are part of a charging network, connected via the internet, and can provide functions such as billing, access control, display screens for communication, advertising, and brand promotions. Prices range from \$2,200-\$4,700 per charging station plus annual networking fees ranging from \$150-\$380 per charging station, warranties after the first year range from \$50-\$400 per charging station. AddÉnergie (FLO) and ChargePoint are the leading companies for Networked solutions.

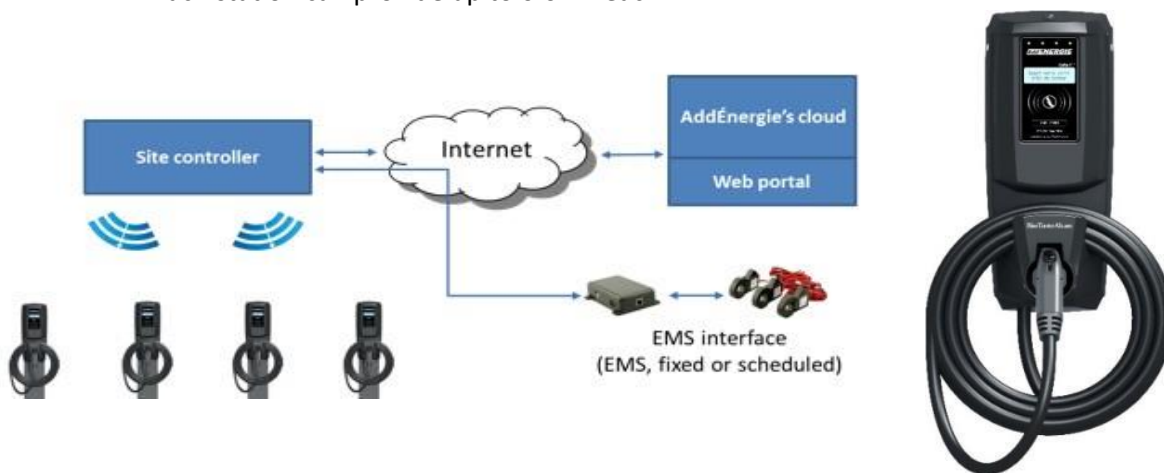
Networked Stations Example

AddÉnergie Technologies – Power Sharing System

AddÉnergie Technologies, a Canadian manufacturer of EV charging equipment, has developed a charging solution specifically designed to address local load constraints. This solution consists of two main components:

1. CoRe+ Level 2 charging stations

- Mounted in pairs, up to 4 stations per installation (another option is available allowing up to 24 stations).
- Each station can provide up to 6.6kW each



2. Site Controller

- Communicates wirelessly with charging stations
- Controls maximum power output of each charging station
- Minimizes charging impact according to building demand schedule or through integration with building energy management system
- Provides internet communications for EV driver user management and usage fee options

Scalability

Another advantage of this solution is that it allows a charging installation to be expanded in the future as needed to support increasing EV adoption. By installing stations in a “daisy-chain” configuration along a single circuit, additional charging stations can be added down the road without the need to add additional circuits, greatly simplifying and reducing the cost of future expansions.

Non-Networked Stations

Non-Networked stations are a great option for many scenarios as the primary function of the equipment is to charge the battery. These stations with simple metering additions can allow for energy monitoring without any subscription fee. Power sharing and access control feature via a key can also be incorporated. Prices range from \$925-\$1,500, there are no annual fees and most stations come with a 3year warranty.

With open source non-proprietary solutions under development non-networked stations could be modified to provide services similar to networked stations. The disadvantage of current non-networked charging stations is they cannot differentiate between users so it is not possible to track energy used by individual users. Therefore, a fixed fee (monthly or annual) must be set recoup costs.

Non-Networked Stations Example

ClipperCreek -Power Sharing System

ClipperCreek's Share2™ enabled HCS-40 bundle. Share2™ allows charging station owners to install two 32A, Level 2 charging stations on one 40A circuit. The Share2™ is an inexpensive solution for any location looking for an easy way to double the number of charge points without running additional 208V circuits.

Features of the Share2™ enabled HCS-40 include:

- Full power charging for one vehicle, split power charging for two vehicles
- Power sharing from a single circuit between two charging stations
- Key based access control option available
- 25-foot charging cable to reach multiple parking spaces



What is OCPP?

The *Open Charge Point Protocol (OCPP)* is an application protocol for communication between EV charging stations and a central management system, also known as a charging station network, similar to cell phones and cell phone networks.

The aim is to create an open application protocol which allows EV charging stations and central management systems from different vendors to communicate with each other.

Charging station owners, or hosts, are less vulnerable to individual system suppliers – if a charging station manufacturer ceased to exist, the host could switch to another OCPP-based network.

Types of Electric Vehicles

Battery Electric Vehicles (BEV)

BEV (Battery Electric Vehicles) are 100% electric and operate using the electricity supplied by the battery. BEVs need to be plugged in to recharge the battery, the process is as simple as charging your phone. BEVs emit zero tail pipe emission because an internal combustion engine is not required.

Plug in Hybrid Electric Vehicle (PHEV)

PHEVs (Plug in Hybrid Electric Vehicle) run entirely on electricity supplied by the batteries until the batteries are depleted, then automatically switch to internal combustion engine/generator. PHEVs have greater fuel savings than conventional and hybrid vehicles.

Extended-Range Electric Vehicle (E-REV)

A type of PHEV that functions as a fully-performing BEV until the battery is depleted, at which point an internal combustion “range extender” (REx) or other auxiliary power unit (APU) is used to power the vehicle to enable longer distances. E-REVs typically have larger battery packs than PHEVs.

Electric Vehicles available in Canada

(not all Electric Vehicles are listed, approximately 30 different models are available)

Model	Type	Electric Range	Battery Capacity	AC Charging Rate*
Chevrolet Bolt	BEV	383km	60kWh	7.2kW
Chevrolet Volt	EREV	85km	18.4kWh	3.6kW
Chrysler Pacifica Hybrid	PHEV	48km	16kWh	6.6kW
Hyundai IONIQ	BEV	180km	28kWh	7.2kW
Jaguar I-Pace	BEV	386km	90kWh	7.2kW
Nissan Leaf	BEV	250km	40kWh	6.6kW

Porsche Cayenne	PHEV	20-30km	8-10kWh	7.2 kW
Tesla Model S	BEV	351-507km	60-100kWh	19.2kW
Tesla Model X	BEV	381-465km	75-100kWh	19.2kW
Volkswagen eGolf	BEV	200km	36 kWh	7.2kW

* The actual charging rate will depend on the minimum of either the Electric Vehicles maximum charging rate or the charging stations available power

EV Related News

Federal:

Canadian Tax Code: Capital Cost Allowance Classes now allows for EV charging stations to be classified at a higher rate than previous allowances. The new rates are:

- Class 43.1 with a CCA rate of 30% electrical vehicle charging stations (EVCSs) set up to supply more than 10 kilowatts but less than 90 kilowatts of continuous power. This is for property acquired for use after March 21, 2016, that has not been used or acquired for use before March 22, 2016.
- Class 43.2 with a CCA rate of 50% electrical vehicle charging stations (EVCSs) set up to supply 90 kilowatts and more of continuous power. This is for property acquired for use after March 21, 2016, that has not been used or acquired for use before March 22, 2016.
- This is useful for businesses that wish to claim depreciation expenses for Federal income taxes.

Provincial:

British Columbia

- HOV lane policy allowing EVs access to the HOV lane regardless of number of passengers
- Provincial Building Act was revised in 2016 to define EV chargers as matters ‘out of scope’ under the Building Act. ‘Out of scope’ is defined as “matters... local government can regulate... if they have authority to do so in other statutes.” This gives local government’s greater flexibility in making decisions regarding the use of EV charging in new developments
- Strata Property Act was revised in March 2017 under regulation 6.9 to clarify that variable user fees are permitted for the use of strata common property. A consumption based rate may be charged to users to recover expenses as long as it is reasonable and in a bylaw or rule. Examples include electricity usage for those charging electric vehicles.

Municipal:

City of Vancouver requiring EV charging in new builds (commercial and residential),

This bylaw was updated on March 14, 2018 to increase the percentage of EV-ready stalls in multi-unit residential buildings from 20% to 100%.

For new buildings current bylaw requires:

- 1 EV-ready stall in single-family homes with garages
- 10% of stalls be EV-ready in commercial buildings
- 100% of stalls be EV-ready in multi-unit residential buildings

City of North Vancouver requiring EV charging in single and multi-family builds.

- Capacity for Level 2 in all parking spaces for single family homes
- Space in the electrical room to support EV charging for all parking spaces
- Outlet for Level 2 in 20% of residential spaces with a branch circuit of at least 40A in multi-family buildings
- New gas station developments must include alternative fueling stations such as L3 (DC Fast Chargers), CNG, Hydrogen, or Propane.

City of Port Coquitlam requiring EV charging in new builds (residential and mixed use).

- One parking space per dwelling unit shall have a Level 2 station with a 240v or 208v circuit breaker on an energized electrical panel connected by raceway to an outlet
- Buildings with common parking (includes mixed-use) shall have a single utility meter and disconnect in line with the electrical panel intended to provide charging of EVs

City of Richmond requiring EV charging in new builds (residential only).

- 100% of new residential parking spaces, excluding those provided for visitors use, shall have access to an adjacent energized outlet capable of providing Level 2 charging.

City of Burnaby requiring EV charging in new builds (residential only).

- The bylaw, which came into effect on September 1st, 2018, will require all new residential parking spaces to have Level 2 (208/240v) energized outlets.

Note: Thirteen local municipalities are expected to announce 100% of stalls be EV-ready in multi-unit residential buildings over the next 12 months.