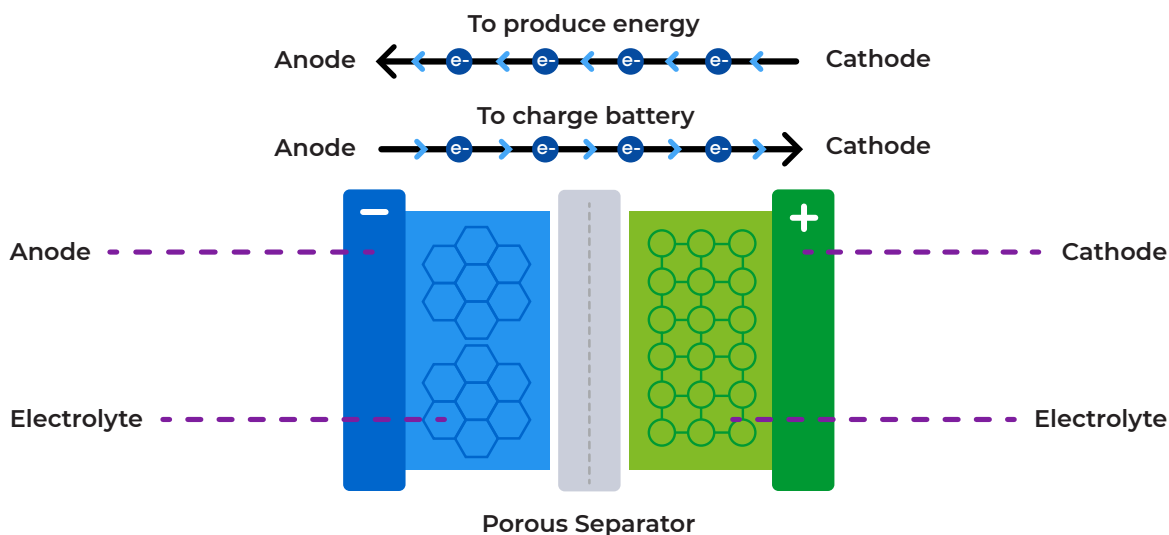




### Lithium-ion Batteries

A battery is a device that stores chemical energy and converts it to electrical energy. Batteries are used to power various equipment such as clocks, flashlights, laptops, electric bicycles, cars, and many other useful items that humans use on a daily basis.

Historically, zero-emission vehicles have had trouble competing with internal combustion engine vehicles, which have been cheaper, faster, and able to travel further distances. With recent technological advancements, specifically the creation of energy dense and lightweight lithium-ion batteries, ZEVs are now becoming more suited to the needs of today's society.



#### What they are:

- There are three main components of a lithium-ion battery: a positive electrode (a cathode), a negative electrode (an anode), and a liquid electrolyte which is a gel that fills the battery so that the lithium ions that contain the cell's charge can flow freely.
- Lithium-ion batteries are important components of zero-emission vehicles, but they are also found in smartphones and laptops.
- Compared to the lead-acid battery (the first type of rechargeable battery), lithium-ion batteries are safer, have a higher energy storage potential, and are quick and easy to recharge.

#### How they work:

- To charge the battery, positively charged lithium ions pass from the cathode through the separator and are stored in the anode.
- When energy is needed, the cell discharges its positive ions, and they pass back through the separator to the cathode, creating an electric current.

Created with support from Natural Resources Canada.



# Zero-Emission Vehicles & Low-Carbon Driving

## Charging Zero-Emission Vehicles

### Electric Vehicle Charging

Electric vehicles (EV) are charged by being plugged in. They can be plugged into a standard wall socket or an EV charging station. There are different charging levels that have varying speeds of charging. The three main charging levels for electric vehicles are:



Level 1 Charging



Level 2 Charging



Direct Current Fast Charging (DCFC)

#### Helpful keyword!

### Voltage

Voltage causes electric charges to move between two points through a wire or other electrical conductor. The unit for voltage is *volt (V)*. Higher voltage means there is the *potential* for more energy.

#### Charging Level

#### Characteristics

##### Level 1 Charging

Charging rate = 8 km of charge/hour

- Approximate time to fully recharge an EV battery = 8-30 hours
- Level 1 charging involves plugging the EV right into a standard 120 V outlet to charge (e.g., the ones you have in your home).
- This is the slowest type of charging but it is the most widely-available and convenient.
- This type of charging is most suitable for locations where a ZEV can be parked for long periods of time (e.g., at a house overnight).

##### Level 2 Charging

Charging rate = 30-50 km of charge/hour

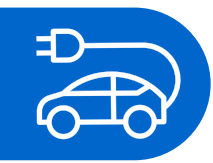
- Approximate time to fully recharge an EV battery = 4-10 hours
- Level 2 charging involves the use of a 240 V outlet (this is more similar to a clothes dryer or stove plug).
- Some EV owners will get a Level 2 charging station for their home; any certified electrician can install them.
- This type of charging is suitable for at home, the workplace, and in public locations (restaurants, parks, or parking lots).

##### Direct Current Fast Charging

Charging rate = 100+ km of charge/hour

- Approximate time to fully recharge an EV battery = 25-30 minutes
- Power is supplied through a 480 V direct current (DC) plug.
- This is most suitable for situations where it is necessary to recharge in a short period of time (e.g., along major highways).
- Due to the associated high cost and required power supply, these are suited to public charging sites rather than residential.

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# Zero-Emission Vehicles & Low-Carbon Driving

## Charging Zero-Emission Vehicles

### Sources

- [Guide to EV Charging](#) (Pollution Probe)
- [Home Charging](#) (Plug'N Drive)
- [Electric Cars and Batteries: How will the world produce enough?](#) (nature.com)
- [Achieving a Zero-Emission Future for Light Duty Vehicles](#) (Clean Energy Canada)
- [Guide to EV Charging](#) (Pollution Probe and The Delphi Group)