

## How Do Electric Cars Work?

Simply put, electric vehicles (EVs) use electricity to propel them forward, instead of gasoline or diesel fuel.

Electric vehicles work like most electric motors.

- An alternating electrical current in the motor acts as magnets with opposite poles
- causing the rotor inside to turn, creating mechanical energy
- driving the wheels forward.

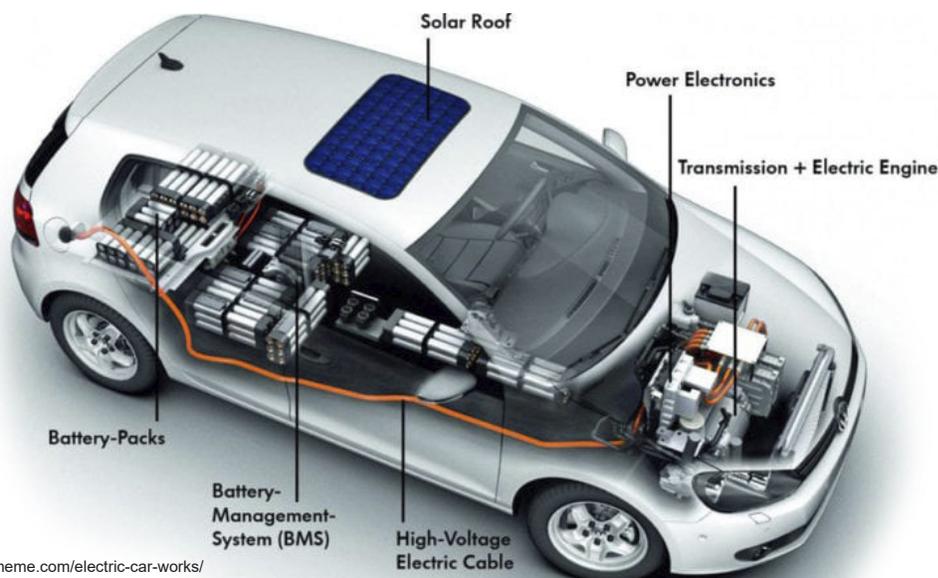
## The Main Parts

- Electric Motor - Supplies power to drive the wheels. AC (alternating current) motors are common.
- Inverter - As most motors are AC and chargers are DC (direct current), an inverter converts the electric current from DC to AC.
- Drivetrain - Unlike traditional vehicles that have gears, EVs have single-speed transmissions.
- Batteries - Stores electricity that power an EV. The larger the battery (kW), the longer the range.
- Charging - Charge ports are in the rear, like traditional vehicles.

## Types of Electric Vehicles

### Battery Electric Vehicles

BEVs are typically shortened to just EVs or electric vehicles since they are the most common form of EV.



<http://www.evme.com/electric-car-works/>

## Hybrid

A hybrid vehicle is mostly gas powered with an ICE engine. When it accelerates or has its breaks applied, it simultaneously charges an electric battery. This saves on fuel but it is not technically an electric vehicle.

## Plug-in Hybrid

PHEVs are similar to hybrids, except they can be plugged in to charge the battery, reducing their dependence on gasoline. Those that are designed mostly as electric cars with just a small capacity to use gasoline as a backup are a better choice.

## Fuel Cell Electric Vehicle

Fuel cell EVs (FCEV) are powered by hydrogen. These are still in the development stage and are worth watching.

## Environmental Benefit

It's mainly about climate change and reducing your carbon footprint.

Internal combustion engine (ICE) vehicles either ignite gasoline with spark plugs or compress diesel and air to ignite and unleash the energy in fossil fuels. This releases greenhouse gases into the atmosphere.

Electric vehicles produce no greenhouse gases when they are operating. However, the electricity used to charge the batteries may result in emissions and, as with all vehicles, emissions are given off when they are manufactured. However, over the lifetime of the EV, the net effect on the environment is much lower than an ICE vehicle.



## Myth 1 - Electricity Is Just As Bad as Fossil Fuel Use

If you produce your own electricity from a solar panel and use this to charge your EV, the environmental benefit is substantial.

If you charge from the grid, the benefit to the environment will depend on where you live. Some provinces like BC, Manitoba or Quebec have most of its power generated by hydroelectric dams, so there are relatively few emissions given off.

Provinces like Alberta and Saskatchewan generate the majority of their electricity with coal and natural gas, which release a significant amount of greenhouse gases. However, the overall emissions are less if you use an EV compared to an ICE vehicle.

If you're interested in researching how many greenhouse gas (GHG) emissions an EV or ICE vehicle would produce in your local area, use this tool on the Canadian Energy Regulator's website:

<https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/market-snapshots/2018/market-snapshot-how-much-co2-do-electric-vehicles-hybrids-gasoline-vehicles-emit.html>

## Myth 2 - EVs Cost Too Much

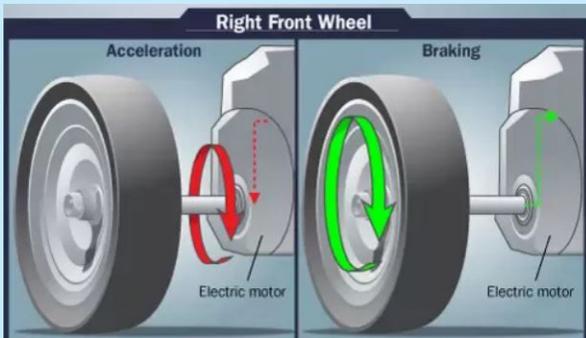
- Electricity is generally cheaper than gas
- A typical ICE vehicle has over 200 moving parts. Electric vehicles can have as little as 17! That is 85% fewer moving parts which mean less maintenance / replacements / break-downs and less expense!
- EVs do not need oil changes.
- You only need to replace the battery every 5-8 years.
- EVs have reduced need for brake pads and discs because of *regenerative braking*\*
- EVs are coming down in price as batteries get less expensive

In other words, EVs might be more expensive to buy, but they could well be cheaper over 3-4 years of ownership.

**Bonus** - when it comes time to sell, you'll get more second hand value back than a fossil fuel car.

### \*What is regenerative braking?

When braking in a traditional car, the energy created goes to waste. However, when an electric car brakes, the electric motor by the wheel reverses direction, becoming a generator which then stores the energy as electricity in the vehicle's battery. Pretty clever!



<https://globalnews.ca/news/4976930/petro-canada-fast-charging-electric-vehicle-stations/>

## Myth 3 - EVs Don't Have Enough Range

Many people are concerned about not being able to travel to remote destinations without being able to find a charging station along the way. The distance an EV can travel on a charge is being continually increased - 400 km on a single charge is becoming more common.

Back in 2016, Statistics Canada reported that the average one-way commute to work in Canada was 22.8 km, which means even those limited-range EVs will work without regular charging overnight or at work.

Most people charge at home so this works out well in the suburbs as well as inner cities.

Range has also been helped by increased charging speeds. Charging stations range from level 1, 2 and 3.

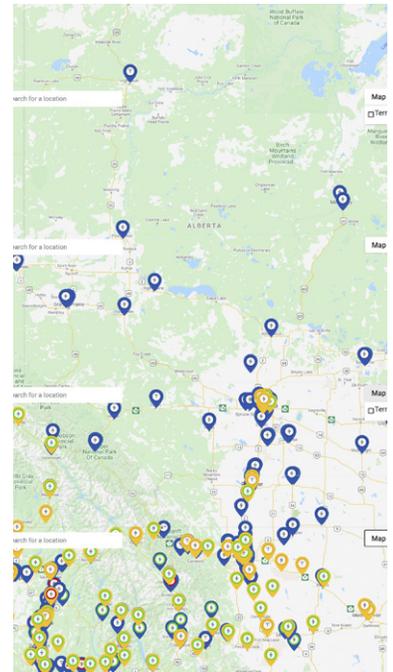
- Level 1 - charge within 8 hours on a normal household 120V outlet.
- Level 2 - charge within 4 hours on a 240V outlet, more commonly found at workplaces.
- Level 3 - charge in around 30 mins, these are commonly referred to as *rapid charging stations*.

rapid charging stations allow travellers on road trips to stop, use a restroom, grab a bite to eat and hit the road fairly seamlessly. It is important to remember that 80% of charging typically occurs at home, so tracking down the closest rapid charging station may not be as dire as one may think.

More charging stations are appearing all the time at parks, grocery stores, malls, and service stations. There are websites and smart phone apps that help you find charging stations so you can plan your trips: Some examples include:

ChargeHub.com (see right)  
<https://chargehub.com/en/charging-stations-map.html>

PlugShare.com  
<https://www.plugshare.com/location/60526>



## Myth 4 – EV Batteries Will Not Last

Electric vehicles use similar batteries as smartphones, but they have drastically different operating conditions:

- Charging frequency - phones are charged daily while the average driver will only charge their EV a few times a month.
- Battery management software - by regulating energy use in EVs, the batteries are more efficient and last longer.
- Active cooling - these systems increase the lifespan of batteries by preventing excessive heat.

Batteries can now last over 500,000 km for an EV with a range of 400 km per charge.

To help put customers at ease, many automakers provide warranties on the battery for at least *eight years* or 160,000 km for 70% capacity. Compare this to the warranties on the average internal combustion powertrain, which is covered for only 100,000 km.



Ford.ca

## Myth 6 – EVs Aren't Safe

The same risks exist for all drivers, no matter how their vehicle is powered, however the design of the EV makes it a safer option.

Automakers treat the battery placement the same way they would treat engine or fuel tank placement. Lithium ion batteries do produce poisonous fluoride gases when on fire, but they take much longer to ignite. The ICE vehicle has flammable fuel on board, making it more likely to catch fire than an EV.

## Myth 7: EVs Lag

People sometimes think lagging is just part of using an electric vehicle. Not so.

Electric vehicles provide instant usable torque - when you step on the accelerator, you go! Most electric cars on the market do 0-60 mph in less than 8 seconds, so a bit less than standard ICE vehicles. Some EVs can do it in under 3 seconds. Immediate, quick, smooth, silent acceleration is the electric car's trademark.

## Myth 5 - Battery Manufacturing Is Dirty

There are two main sources of lithium, and mines are only one of them. The vast majority (87%) of lithium comes from brine (from the sea). And remember, it is used in mobile phones and laptops and can be recycled.

Cobalt is the other rare mineral that is of concern but EV makers are reducing and eventually hope to eliminate cobalt from their batteries since it's very expensive.

Auto manufacturers and energy companies are working to reuse EV batteries in energy storage solutions, typically for use with solar panels or wind turbines.

Battery recycling can extract economically valuable metals such as lithium, nickel, and cobalt and use in new batteries, limiting waste.

## Useful Links

Electric Vehicles - Natural Resources Canada

<https://www.nrcan.gc.ca/energy/efficiency/transportation/travelling-electric-vehicle/19198>

How Your Car Can Make the Air Cleaner - Consumer Report

<https://www.consumerreports.org/emissions/how-your-car-can-make-the-air-cleaner/>

Electric Vehicle Basics - Environmental Protection Agency

[https://www.energy.gov/eere/electricvehicles/electric-vehicle-basics#:~:text=AEVs%20\(all%2Delectric%20vehicles\),Cell%20Electric%20Vehicles%20\(FCEVs\).](https://www.energy.gov/eere/electricvehicles/electric-vehicle-basics#:~:text=AEVs%20(all%2Delectric%20vehicles),Cell%20Electric%20Vehicles%20(FCEVs).)

Electric Vehicles 101 - Natural Resources Defence Council

<https://www.nrdc.org/experts/madhur-boloor/electric-vehicles-101#:~:text=The%20difference%20is%20even%20starker,motor%20typically%20has%20just%202.>

Video - Electric Cars & Global Warming Emissions - Union of Concerned Scientists

<https://www.youtube.com/watch?v=K9m9WDxmSN8&action=share>

Video - Demystifying Electric Vehicles -AskNRCan

<https://www.nrcan.gc.ca/simply-science/demystifying-electric-vehicles-asknrcan/20489>

## Battery Gold with Recycling!

Li-Cycle is a Canadian company from Ontario that is taking the mounting heap of battery waste and turning 95 per cent of it into "gold" – battery-grade raw materials for new batteries. See the video:

<https://www.youtube.com/watch?v=qwmLyNTzf-0>

