EV Handbook

ELECTRIC VEHICLE OWNERSHIP BASICS

With thanks to the **NB EV Owners Group** for providing much of the information shared in this handbook.

UPDATED:

July 2023

Are you considering buying an EV and wondering what it will be like to own and drive? Or perhaps you have already taken the plunge and now you are looking for some help figuring out some of the basics.

Either way, this is for you! We'll walk you through the basic steps for charging, maintaining, and driving your car throughout the year.

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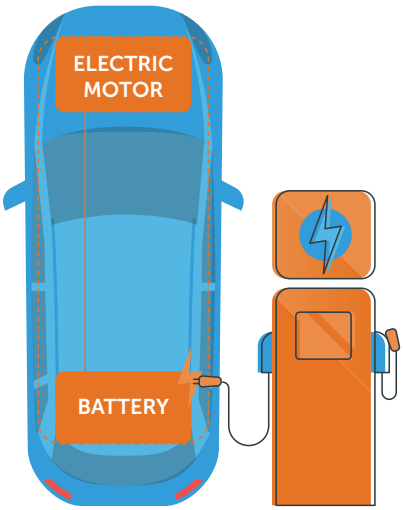
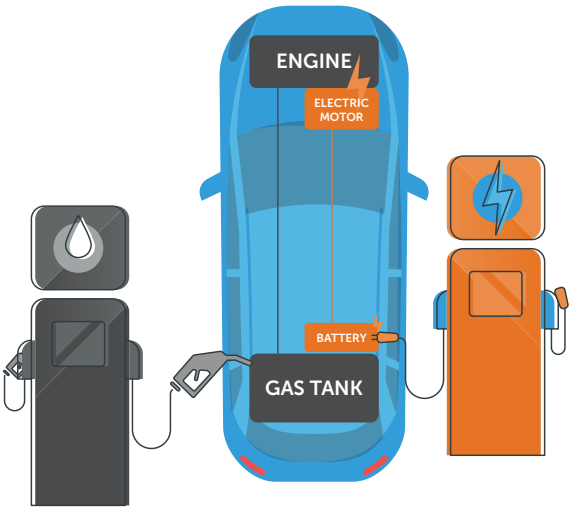
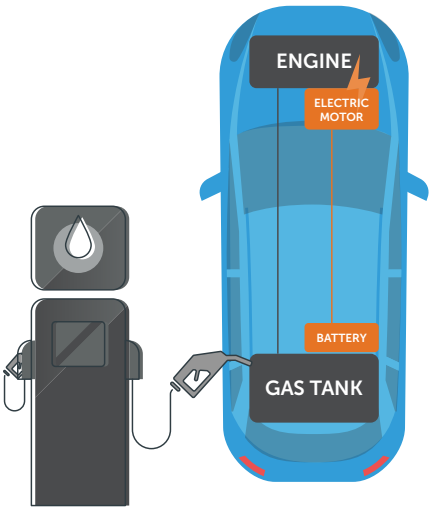
Vehicle Types



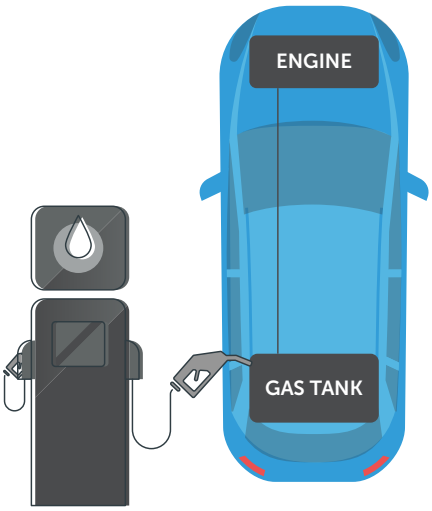
BEV:
Battery electric vehicle. Uses electricity only.



PHEV:
Plug-in hybrid electric vehicle. Uses electricity and gasoline.

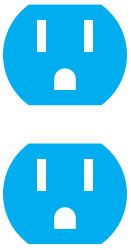


HEV:
Hybrid electric vehicle. Uses gasoline only but has a small battery and electric motor to improve efficiency.



ICE VEHICLE:
Internal combustion engine vehicle. Currently, most vehicles on the road fall into this category. Uses gasoline/diesel exclusively.

Charging Levels

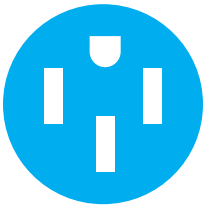


OUTLET:
120 volt

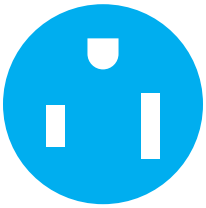
PLUG:
J1772

Level 1 (Basic Charging)

Level 1 refers to charging from a regular household 120-volt outlet. All EVs come with a kit, also referred to as a mobile charger or electric vehicle supply equipment (EVSE), which allows you to charge from a regular wall outlet. This is the slowest charging method but even so, many EV drivers find an overnight charge at Level 1 is more than enough for a typical day's driving. Depending on battery temperature among other factors, a 10-hour overnight charge could add over 85 km of range. For details on how to calculate this, see our Range Calculation on Page 11.



OUTLET:
240 volt
NEMA 14-50



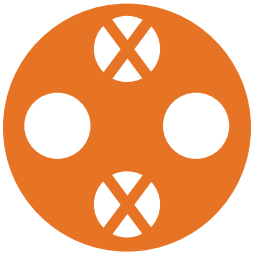
OUTLET:
240 volt
NEMA 6-15

PLUG:
J1772

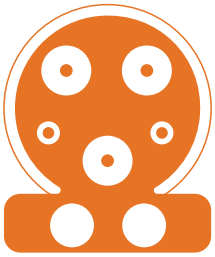
PLUG:
Tesla

Level 2 (Regular Charging)

Level 2 chargers all require 240-volt outlet similar to an electric oven or dryer. These chargers are installed at home and at commercial locations such as stores and hotels. These chargers have either a J1772 (also called type 1) connector or a Tesla connector. An EV may even come with a cable which plugs directly into a 240-volt outlet. The most common is the J1772 connector. Adapters are available to allow Teslas to use a J1772 connector at Level 2 chargers only. The maximum charging power typically varies from about 7 kW to 19 kW or more. The most common being 7 kW. Depending on current battery charge, temperature, and many other factors, a 5-hour charge at 7 kW could add over 175 km of range depending on the consumption of the vehicle.



PLUG:
CHAdeMO



PLUG:
CCS1

DCFC

Direct Current Fast Chargers (DCFC) are used when you want or need to minimize the time spent charging. That typically happens when your road trip is longer than one charge will take you. Fees for this type of charging and convenience are higher.

There are two types of connectors for DCFC: CCS and CHAdeMO. All EVs can use one or the other although Teslas need an adapter. The charging power can range from 22 kW to 360 kW, with some newer models having power over 360 kW.

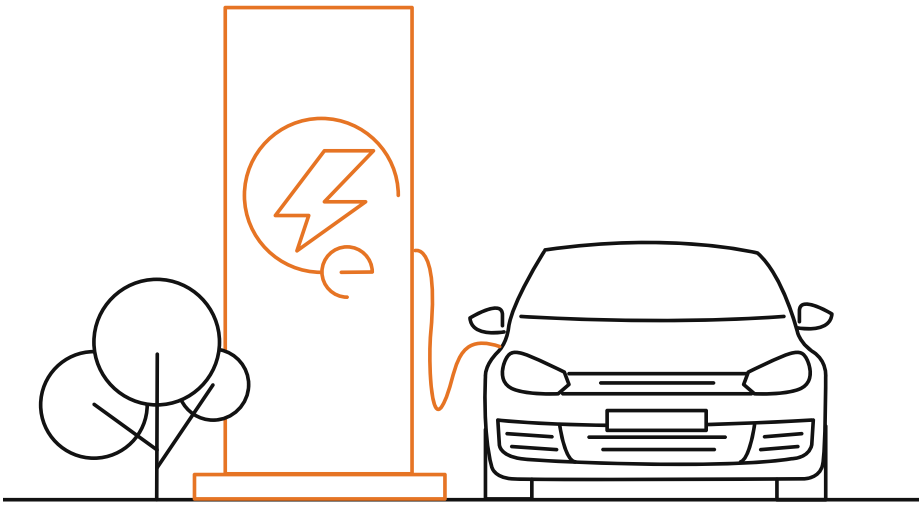
Actual charging power/speed depends on current battery charge and temperature, among other factors. Note that most PHEVs do not support DCFC.

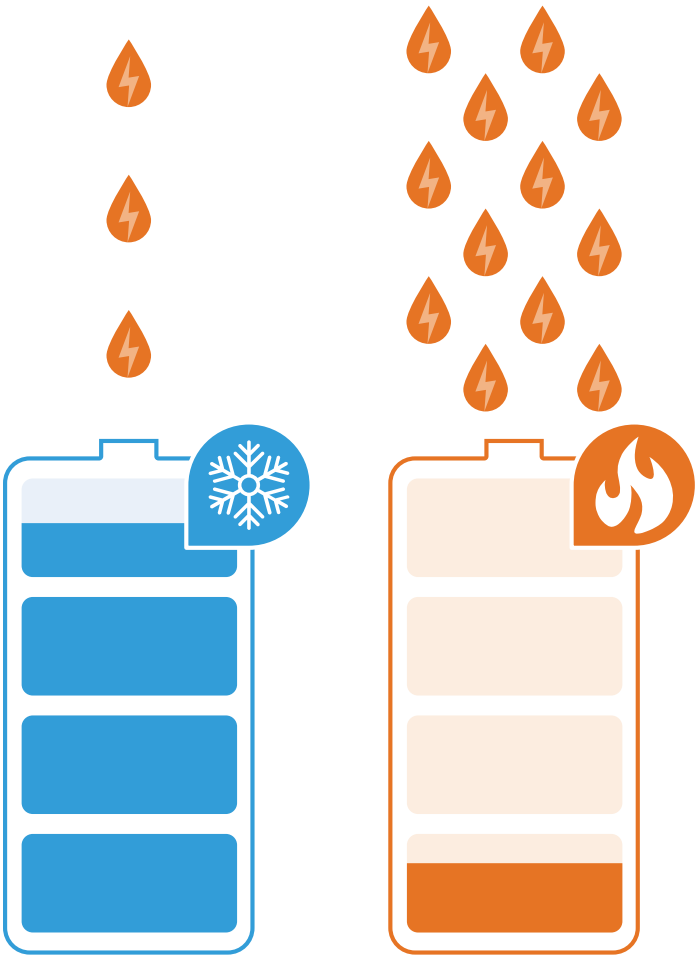
PLUG:
Tesla

Tesla Superchargers

Superchargers are Tesla's proprietary version of DCFC chargers. In North America, these only have Tesla connectors.

Maximum charging power is at least 100 kW and as high as 250 kW. Actual charging power/speed depends on current battery charge and temperature among other factors.





Conditions Affecting Charging Speed

In addition to the capability of the charger and the EV, charging speed depends on the current charge level of the battery and the battery temperature, among other factors (see below for details on what those factors are). Generally, a battery which is hot or cold or close to fully charged or almost fully discharged will charge slower than a warm battery with a partial charge. If you always charge at home, you may never notice this effect.

When using a DCFC station like you would on a road trip, this effect becomes very noticeable. As a guideline, it tends to be faster and cheaper to plan to charge from 10–20% to 80–90% at each stop. This prevents overheating of the battery and preserves battery life.

Factors

- Level and size of EV charger
- Battery size and amount of charge left (State of Charge)
- Temperature
- The EV's maximum power acceptance rate
- Battery deterioration
- Other loads in use while charging (heating seats, music....)

Charging at Home
Level 1 & Level 2

One of the best benefits of an EV is that it can be conveniently and cheaply charged overnight at home. Most EV owners do most of their charging at home where it's cheap and convenient. You can install a wall mounted charger or simply plug your EV into a regular (120-volt) or 240-volt wall outlet. Typically, an EV driver arrives at home at the end of the day, plugs in their EV and doesn't think about it again until it's time to leave in the morning. Most EVs come with the ability to schedule charging for off-peak times. That allows you to automatically reduce the peak load on your local power utility and reduce your power costs in areas with off-peak rates.

EV batteries are designed to last 10–20 years or more. You can ensure you get the most life out of your battery by keeping the charge level between 20% and 80%. This is easy to do by using the charge scheduling features built into your EV (or some chargers) to finish charging to 80% prior to your departure each day or right before long trips. Some recent EV models use lithium ferro-phosphate (LFP) batteries. If your EV uses a LFP battery then you can simply top it up to 100% each night, if you wish, without affecting its lifetime capacity.

When you do fully or almost fully charge your EV then it is best to minimize the amount of time that the battery sits at a high charge level by driving soon afterward. 80% is considered a conservative guideline, not a rule, so don't worry about bending it. As suggested above, this does not apply to EVs with a LFP battery. Check with your manufacturer/dealer.

Public Charging Stations
Level 1, Level 2 & DCFC

Most public charging stations are set up in networks provided by companies that require you to set up an account with them in advance. A few examples include the eCharge Network, FLO, ChargePoint, Circuit électrique, Tesla, and many more. Fees are displayed as $/per hour rate but are billed by the minute. Some public charging stations are free to use, some require a special condition (e.g. you need to be a customer of the business that owns it), and some will accept a credit card at the charging station (e.g. Petro-Canada charging stations).

To decide which network(s) would be best for you, find out which has charging stations in areas you are likely to travel to or through. Plugshare.com is one of the best websites to find charging stations.

Once you've created an account the charging network will issue you a card and/or provide a smart phone app, either of which can be used to activate charging sessions. You'll need to use your credit card to add funds to the account which you draw from each time you charge. The only exception to that rule is Tesla, which automatically charges your credit card each time you use a Tesla supercharger.

Calculating the Cost to Charge

Cost ($) = output power (kW) × charge time (hours) × electricity rate ($/kWh)

Take the **lowest value** of either the charger's output power (eg: 7.2 kW) or the EV's onboard power acceptance rate (eg: 10 kW): 7.2 kW

Charging time in hours: 8.5 hours

Electricity rate (eg: 12.15 ¢/kWh): 0.1215 $/kWh

Tax: 15%

Electricity rate including tax (115% × $0.1215/kWh): $0.1397/kWh

Cost: 7.2 kW × 8.5 hours × 0.1397 $/kWh = $8.55

CALCULATING THE POWER OF THE CHARGER

Power (W) = current (A) × voltage (V)

Current: 30 A
Voltage: 240 V

30 A × 240 V = 7,200 W

$$\frac{7{,}200\ \text{W}}{1{,}000} = 7.2\ \text{kW}$$

Calculating the Time to Charge

(from empty to full)

$$\textbf{Time to charge (hours)} = \frac{\textbf{battery capacity (kWh)}}{\textbf{charge power (kW)} \times \textbf{average power efficiency (\%)}}$$

Size of battery: **70 kWh**

Take the **lowest value** of the charger's output power (9.6 kW) or the EV's onboard power acceptance rate (10.5 kW): 9.6 kW

Efficiency factor *(to compensate for the capacity losses during charging to be conservative)*: 90% efficiency

$$\frac{\textbf{70 kWh}}{\textbf{9.6 kW} \times \textbf{90\%}} = \textbf{8.1 hours}$$

Public Charging Etiquette

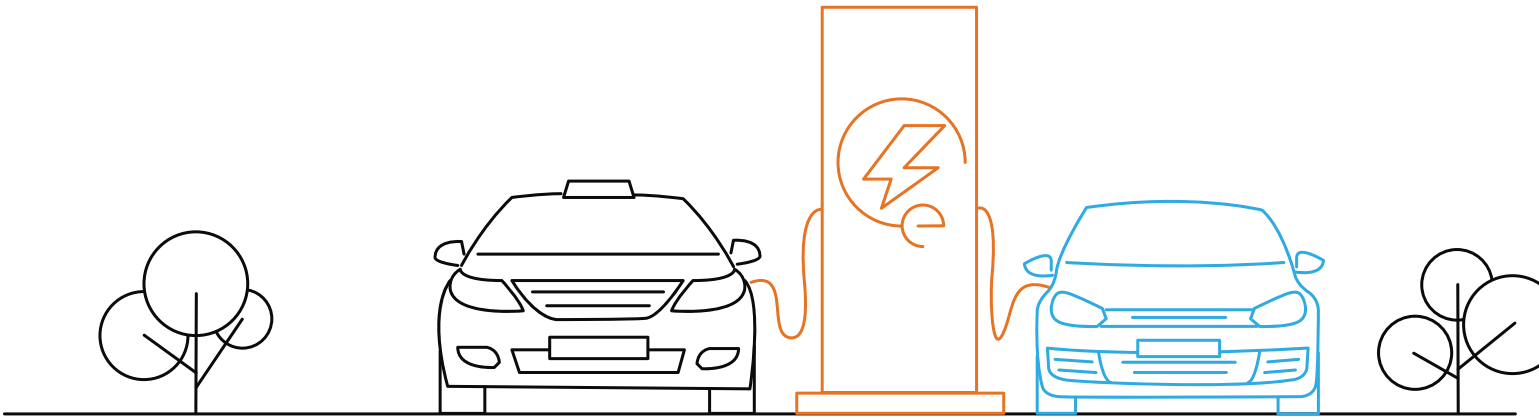
Occasionally, you may find that a public charger has been blocked by an ICE vehicle parking in a "EV Charging Only" spot. The common phrase for that is "the charger has been ICEd."

Many ICE drivers are unfamiliar with the importance of leaving access to chargers for EVs. Although being unable to access a charging station can be frustrating, it is good etiquette and most effective, to choose to educate rather than complain. If the driver is present, then ask them to move and explain why. If the driver is not present, leave a note with an explanation. You could draw a comparison to blocking access to a gas pump. Often, people are simply not thinking in those terms. Our goal as early EV advocates is to build awareness and understanding.

Also, don't forget the "Charging Only" part of "EV Charging Only". If you don't need to charge or have finished charging, then move your EV so the charger is available for others.

Please help the EV community by checking in on plugshare.com when you charge. This is helpful for many reasons:

1. EV drivers looking for a charge can tell immediately which chargers are already in use.
2. If you have problems using a charger, you can indicate that on plugshare.com which will warn other EV drivers.
3. Chargers can break down or have intermittent issues so seeing that a charger has had lots of recent successful check-in's can be very reassuring.
4. Adding a comment or photo to the charging station on plugshare.com can help the next driver find and use the station especially if it has any special quirks.



Range

The range of a specific EV model is how far it can travel on a 100% charge in perfect settings (temperature, road, traffic, cargo load, tire pressure, etc.). The most used range estimate is published by the US Environmental Protection Agency (EPA). The EPA combines highway (55%) and city (45%) range estimates together to produce a single number which represents typical vehicle usage.

EVs are far more efficient driving in the city than on the highway due to their regenerative braking and the fact that electric motors do not need to idle (at red lights). That means they will exceed the EPA estimate in the city but not on the highway. It's a good idea to try out the efficiency of your EV on the highway before heading out on a long trip. That will help you more accurately plan your charging stops.

Another factor in range is the friction caused by air resistance at highway speeds. This plays a major role in reducing vehicle efficiency for both ICE and EV. Even worse, air resistance goes up dramatically as speed increases. A head wind contributes to this. Simply driving at the posted highway speed limit usually contributes to a very good range. Slowing down even 5 km/h at highway speeds can result in significant savings.

A final note about range is the effect of weather. A warm battery performs better than one which is cold or hot. Also, cold/hot weather places more demands on the battery as the cabin air needs to be heated or cooled to keep the passengers comfortable. Wet or snowy roads will also reduce range.

To minimize the effects of temperature extremes on range, try these tips:

1. Warm up (cool down) the cabin air before unplugging your EV from the charger.
2. In cold weather, schedule charging so that it finishes just before you leave. Charging warms the battery.
3. In hot weather, park your car in the shade or other cool spots.

Use these features freely as they use very little power:

1. Radio and/or sound system.
2. GPS navigation.
3. Phone charger.
4. Electrically heated seats.
5. Heated steering wheel

Range Calculation

Calculating how much range (km) will be added when charging at a level 1 charger (EVSE).

Temperature among other things can affect charging time but is not included in this example as there is a lot of debate on how to really include it in the equation. If you want to be more conservative, some people use an efficiency factor of 90% since the electricity from the grid to the EVSE to the EV is not at 100% efficient.

Maximum charging power (kW) = current (A) × voltage (V) × $\frac{1\ W}{1{,}000\ kW}$

FOR A 15-AMP BREAKER:

Maximum charging power (kW)= 12 A × 120 V × $\frac{1\ W}{1{,}000\ kW}$ × 90% efficiency = **1.3 kW**

FOR A 20-AMP BREAKER:

Maximum charging power (kW)= 16 A × 120 V × $\frac{1\ W}{1{,}000\ kW}$ × 90% efficiency = **1.7 kW**

Km per kWh

Approximate range added (km)= $\frac{\textbf{charging power (kW)} \times \textbf{charge time (hours)}}{\textbf{consumption (kWh/km)}}$

EXAMPLE

Let's assume your receptacle is 20-amp (according to above calculation): 1.7 kW
Charging time: 10 hours
Consumption of a vehicle: 20 kWh per 100 km
(to do the formula, it's easiest to bring the km up to the top line and multiply before dividing)

Approximate range added (km)= $\frac{\textbf{1.7 kW} \times \textbf{10 hours} \times \textbf{100 km}}{\textbf{20 kW}}$ **= 85 km**

Road Trips

Road trips do require a little preparation.

1. Plan your charging stops in advance.

Plugshare.com and abetterrouterplanner.com are both excellent sources of charger location and availability. If you expect wet or snowy roads or a strong head wind, then expect to use more energy between charging stations.

2. Charge at your nightly accommodations.

To reduce charging costs, book your overnight stays at places with chargers or at least an available 120-volt outlet.

3. Acclimatize your vehicle while charging.

Preheat (or precool) your EV before unplugging. Once the cabin has been heated it takes much less energy to keep it heated. Also, note that using heated seats to help stay warm uses far less power than heating the cabin.

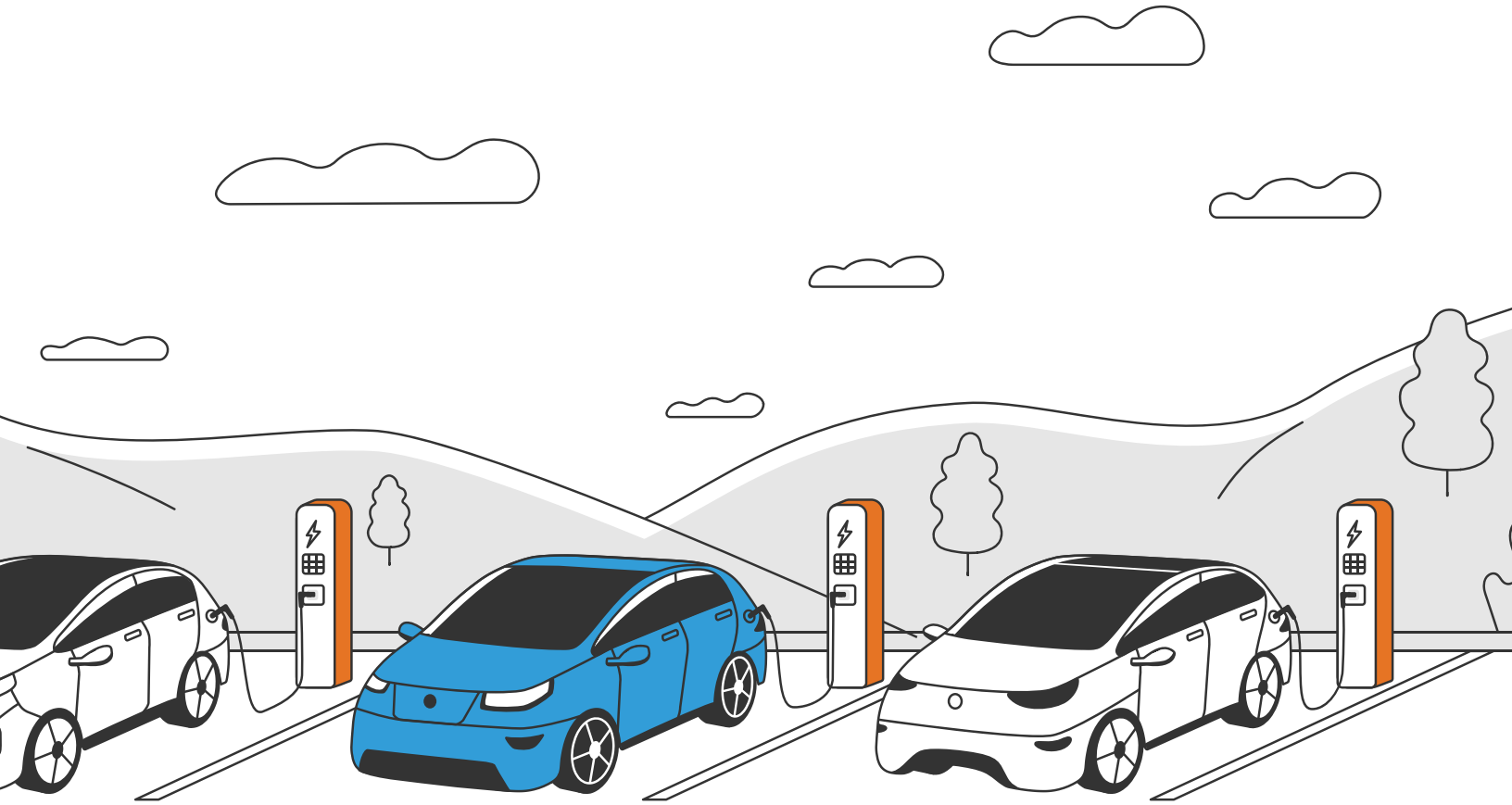
4. Check your tire pressure.

For safety and the best range (efficiency), check your tire pressure for the recommended level. When there is a big temperature change, you should always check your tire pressure to add or remove pressure. Remember, the colder it gets, the more air it needs. The hotter it gets, the less air it needs. Never check your tire pressure after driving, ensure the car is parked for at least two hours before checking the tire pressure.

5. Monitor your battery use.

When you are on the highway and notice the charge level is going down faster than you expected, here are a few things to try.

- Slow down. Even driving 5 km/h slower makes a significant difference at any speed above 90 km/h.
- Reduce the amount of cabin heating. Use your heated seats instead.
- Check to see if there is a closer charger. Even a level 2 charger should be able to quickly add enough charge to get you to the next DCFC.



Running Out of Charge

Uh-oh. After all that careful planning, what if you still end up on the side of the road without enough charge to get to your destination?

Here are some things you can do to help get you to the next charger. It's best to always keep your mobile charger (level 1) in the EV, just in case.

1. Check your EV's navigation system or plugshare.com for a nearby charger. Be sure to check for level 2 or 3 or even a publicly available outlet. Chargers are continuously being added so one may be closer than you think. Some people even add their home charger to plugshare.com to help fellow travelers.
2. When you realize that you are not going to make it to the next charger, try stopping at a business and ask if you could plug into an (120v) outlet for a while.
3. Some roadside assistance services, such as CAA, may provide roadside charging although this service isn't yet widely available.
4. If all else fails, then get your EV carried on a flatbed tow-truck to the nearest charger.

Winter Driving

Freezing temperatures both lower battery performance and increase power demands due to the need to heat the passenger cabin. You may experience a 10-30% decrease in range depending on weather conditions, EV model and driver experience. See the section on range for tips on reducing the effect of cold weather on range (p. 10–13).

When an EV is parked in the cold (especially below 0°C) it will use battery power to keep the battery itself from getting too cold. That means if you need to park in cold weather for an extended period, e.g. days, then it's a good idea to keep your EV plugged in.

An EV battery is heavy and located at the bottom of the car. This tends to improve traction and stability but it's always a good idea to install good quality winter tires for the snowy season.

Regenerative (Regen) Braking

Regenerative or regen braking uses the motor to slow down the EV and uses the energy to charge the battery. It saves power, extends range, and reduces wear on regular hydraulic brakes.

Regen braking is automatically activated when you reduce the pressure on the accelerator pedal.

Some EVs also provide a stalk or paddle on the steering wheel column to activate regen braking. Just like in an ICE vehicle, reducing pressure on the accelerator pedal slows you down. The difference with an EV is that you'll notice that the same action has more effect. People call it "one pedal driving" because you can both speed up or slow down simply by adjusting how much you press on the accelerator pedal. Note that the effect of regen braking may be reduced if the battery is cold or nearly fully charged. Of course, the brake pedal is still there if you need to brake more quickly.

Maintenance

EVs have very little maintenance compared to an ICE vehicle. No oil changes, no exhaust system to fix or spark plugs to replace, and less fluids that require regular maintenance.

To identify the few things you do need to maintain, check the manual for your EV. (You may need to use the manual to convince shops inexperienced with EVs that tune ups are required less often.)

One thing to keep in mind is the regular hydraulic braking system.

Thanks to regenerative braking, that system doesn't tend to work very hard. That can cause the abundance of salt and sand on winter roads to creep into your brakes, reducing your driving range. To avoid a loss in range and unnecessary brake wear, be sure to have the brakes cleaned and lubricated each spring when you take off your winter tires.

Home Charger Installation

One of the best benefits of an EV is that it can be conveniently and cheaply charged overnight at home. While a regular outlet may be sufficient, many EV owners install a wall mounted level 2 charger for flexibility. The setup of a charger involves installing a circuit similar in power to that used for an electric oven.

Mount your charger inside your garage or outside as close to your parking area as possible. Charger models range from basic to Internet-based features. Some models may be eligible for rebates in your area. Check before buying.

For any electrical work, it is best to hire a licensed electrician to ensure the installation is safe and reliable.

Calculating the Cost to Drive

Cost ($) = distance (km) × consumption (kWh/100km) × (electricity rate ($/kWh) + tax)

Vehicle's energy consumption: 20 kWh/100 km
Electricity rate (eg: 12.15 ¢/kWh): $0.1215/kWh
Tax: 15%
Electricity rate including tax (115% × $0.1215/kWh): $0.1397/kWh

Cost to Drive per km

Distance: 1 km

$$\text{1 km} \times \frac{\text{20 kWh}}{\text{100 km}} \times \text{\$0.1397/kWh} = \textbf{\$0.028 per km}$$

Cost to Drive per Year

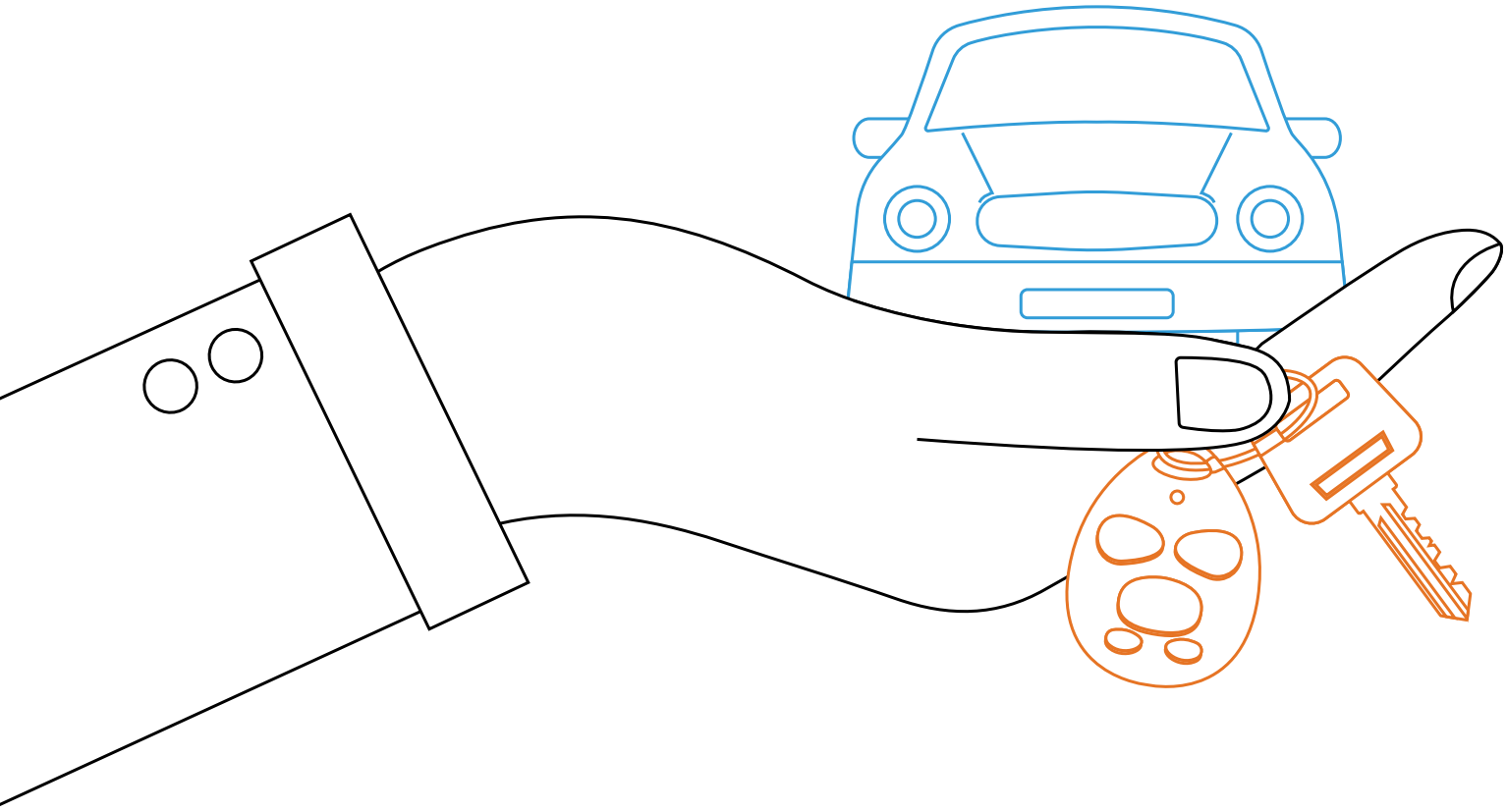
Distance in a year: 15,000 km

$$\text{15,000 km} \times \frac{\text{20 kWh}}{\text{100 km}} \times \text{\$0.1397/kWh} = \textbf{\$419.10 per year}$$

Cost to Drive 100 km

Distance in a year example: 100 km

$$\text{100 km} \times \frac{\text{20 kWh}}{\text{100 km}} \times \text{\$0.1397/kWh} = \textbf{\$2.79 per 100 km}$$



Ordering Your First EV

Buying any vehicle, electric or not, is a big decision and needs careful consideration. Here are a few recommendations for everyone, including long-time vehicle owners.

1. Consider your need for range.

Too little range can be frustrating and too much range means you've bought a battery too big/expensive for your needs. That said, no one complains about too much range.

2. Consider how & where you will charge.

Think about how you'll charge for a typical week of driving such as commuting, etc. The best is being able to charge at home but that's not always possible, especially for apartment dwellers.

3. Learn from others.

Ask lots of questions to your friends, neighbors or colleagues who own an EV, especially those who have the vehicle you are considering. Don't worry about asking any questions, the owners are generally happy to answer.

4. Plan your order.

Delivery time for many vehicles, especially EVs, are currently quite long. Check the wait period for the vehicle(s) you are considering and plan appropriately.

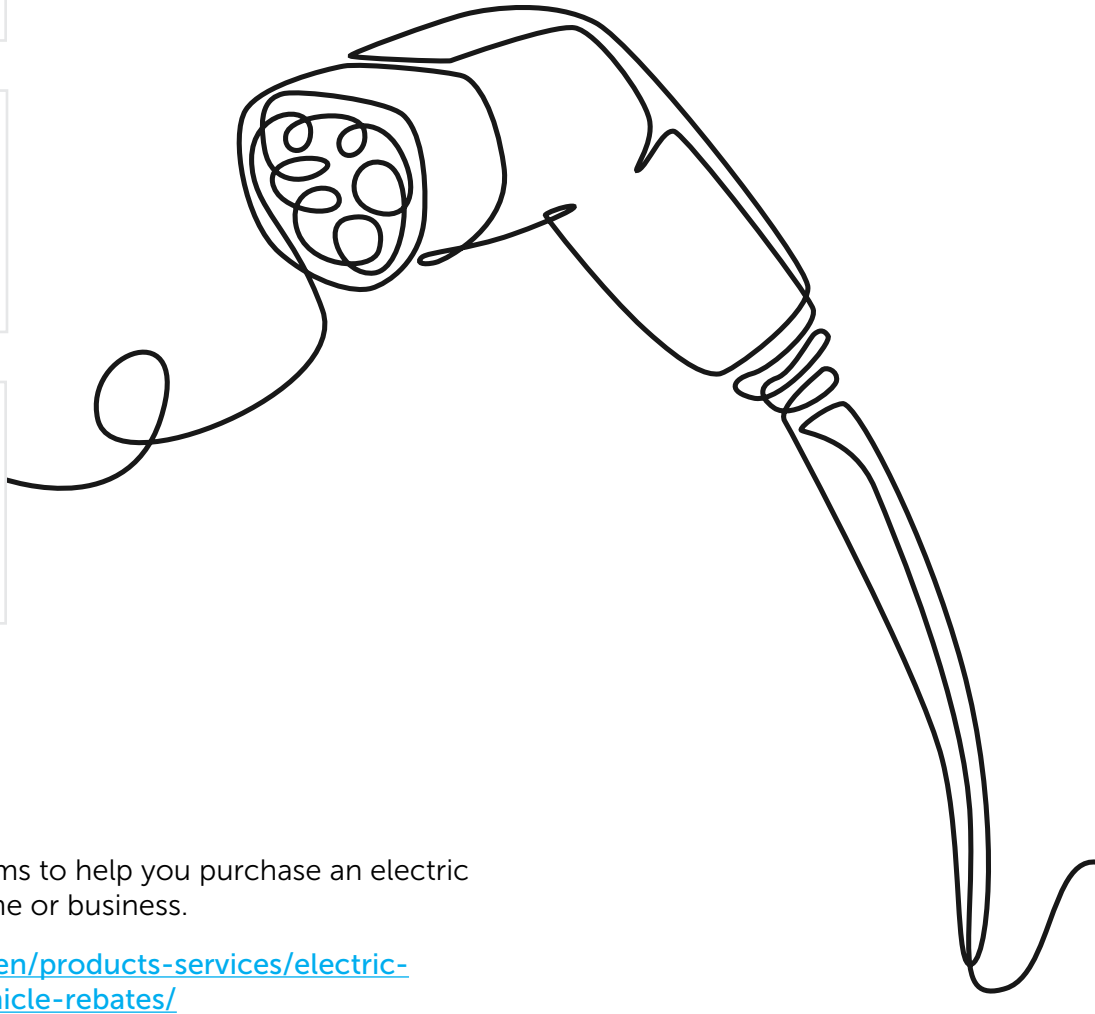
Support & Communities

Do you still have questions? No problem! Many EV owners are very happy to help by answering questions, walking you through your first public charge, etc, just ask. Here are just some of the many EV groups across Canada:

EVSOCIETY.CA

EVAAC.CA

NEW BRUNSWICK EV OWNERS
FACEBOOK GROUP



Incentives

There are a few incentive programs to help you purchase an electric vehicle and charger for your home or business.

For details: www.nbpower.com/en/products-services/electric-vehicles/plug-in-nb/electric-vehicle-rebates/

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SUPPORTED BY:

Énergie NB Power

the power of possibility