

Qmerit

# Best Charging Options for Your Electric Vehicle Battery





Electric vehicles are becoming increasingly popular as more people opt for eco-friendly and cost-efficient alternatives to traditional vehicles.

**However, with this new mode of transportation comes a new set of terminology and charging methods that can be confusing for many.**



Your electric vehicle (EV) offers many benefits, particularly in terms of fueling costs and regular maintenance, but there are misconceptions associated with how best to charge EV batteries.

In this article, we will explore the different types of electric vehicles and the charging methods available. We will also discuss how rapidly electric vehicles charge and the factors that can impact your charging speed, as well as demystify the process of EV charging while giving you a

clearer idea of your options when it comes to powering up your EV. We'll also cover federal, state, and other local financial incentives in addition to offering tips on how to make your EV charging even more affordable and convenient.

By the end of this article, you will have a better understanding of EV terminology and the available charging options for your electric vehicle so you can charge your electric vehicle with confidence.



# EV Charging Terminology

Learning EV terminology will help you better understand your electric vehicle's charging needs and available charging options:



## Charging station

Simply put, the charging station is where you power your EV. Owners typically have access to Level 1, Level 2, or Level 3/DCFC chargers at or near where they live and work. We'll further break down these charger types later in this guide.



## EVSE

Electric Vehicle Supply Equipment. This acronym refers not only to an EV charging station in general but also to all the specialized equipment within a charging station. That specialized equipment, such as computerized load balancers, helps ensure safe and efficient EV charging.



## AC Charging

Alternating current, or AC, is the standard for both household and commercial electrical service. Level 1 and Level 2 charging stations use AC power.



## DC charging

Direct current, or DC, is generally available only to commercial and industrial customers. Level 3 stations utilize DC service and are thus known as DC fast-charging (DCFC) units. These high-powered charging stations allow for much prompter recharging speeds, but that quick charge can also degrade the battery over time.



## Kilowatt

A kilowatt, or kW, is the rate or speed at which the EV charging station delivers power to the EV battery. To use an analogy, imagine you're using a hose to fill a bucket. The bigger the hose diameter (i.e., the higher the kW of your charger), the faster you can fill the bucket.



## Kilowatt-hours

A kilowatt-hour, or kWh, measures the total amount of power delivered from a source to the device which uses it. To use our hose-and-bucket analogy again, this is the total amount of energy delivered by the hose to the bucket. The difference between kW and kWh, then, is that kW measures how fast energy was delivered, while kWh measures how much energy was delivered.

**If the details feel a bit overwhelming, don't worry. The more you familiarize yourself with your EV's features and read about your charging options, the easier it will get.**



# What Charging Methods Are Available for Your EV?

The type of vehicle you have may limit your charging or fueling options:

- **Hybrid electric vehicles (HEVs)** have both a gasoline engine and an electric motor. A prime example is the Toyota Prius. HEVs don't need a cable connection to recharge, because the car's gasoline engine continually recharges the electric motor's small battery.
- **Plug-in electric vehicles (PEVs)** are similar to hybrid vehicles, but they have larger batteries and larger electric motors. Their electric battery does need to be recharged, and their gasoline engine needs fuel. Thus, these vehicles have both a gas tank and a charging port.
- **Battery electric vehicles (BEVs)** are true electric vehicles because they have no gasoline-burning engine and no gas tank. These vehicles are powered solely by the electric charge stored within their battery pack.
- **Internal combustion engine vehicles (ICE vehicles or ICEs)** are conventional gasoline-powered or diesel-powered vehicles, including cars, trucks, and SUVs.



While we'll explore BEVs here, the charging information for BEVs also pertains to PEVs. Cost information and charging speeds will vary, but the recharging options, equipment, and strategies still apply. Additionally, many incentives and rebate programs are available for both BEVs and PEVs.



## How Fast Will My EV Charge?

Charging speeds vary by several factors — namely, the charging speed, the size of the EV's battery, and the rate at which the EV can accept a charge. To understand how these variables interact, let's look at the different options.

### EV owners in the U.S. have three charging speed options:

- **Level 1 charging** is the slowest of the three options and is sometimes referenced as “trickle charging”. In our analogy above, think of the Level 1 charge speed as water streaming out of a very thin hose. In this case, Level 1 charging is generally rated at approximately 1.0 to 1.4 kW and will only provide 3-5 miles of travel distance per hour of charge time. This type of charging is thus best used when the EV will be parked for at least 12 hours, preferably longer. Fully charging a deeply depleted battery via a Level 1 charger can take up to 40 hours. It can also be used in an emergency to recharge a very low battery just enough to reach a nearby Level 2 or Level 3 charging station. Since any household outlet can be used for Level 1 charging, it is thus compatible with standard residential AC electrical service.
- **Level 2 charging** is notably faster than Level 1, with a 6.0 to 19.2kW rate of charge, which provides between 25 to 60 miles of range for each hour charged. This would be equivalent to a larger

garden hose. Level 2 charging stations require a more robust electrical service, of 240V, and a dedicated outlet. A professional charging station installer can easily upgrade most households' electrical service to accommodate Level 2 charging. A Level 2 charging station should always be professionally installed by a certified installer.

- **Level 3 charging**, also known as supercharging or DCFC, is the fastest option. A DCFC charging station will offer a charging rate of 50 kW to 350 kW. For most EVs, that provides full charging within 15-45 minutes. To continue with our hose analogy, a DCFC charging station is roughly equivalent to a fire hose delivering massive amounts of water under high pressure. Due to the DC requirements and the much higher rate of charge, these stations are not for residential use and are typically only installed in public-use areas or fleet charging stations.

*NOTE: Frequent use of DCFC charging (more than 3 times/month) will result in premature battery pack degradation. In simple terms, fast charging is hard on a battery pack because so much energy is*



being forced into the battery pack so quickly. Given that a battery pack replacement is a costly repair, EV owners should not rely on DCFC charging except for occasional convenience and/or during occasional long-distance travel.

### Next, it's important to consider a given EV's battery size.

Heading back to our water analogy, think of the EV's battery as a bucket. The bigger the battery, the bigger the bucket — just as we fill a bucket with water, we fill a battery with energy. Therefore, a small battery will provide fewer miles per charge compared to a larger battery. When we drive, we empty the energy from the battery, or bucket, into the motor, in order to run the vehicle. When we recharge, we are essentially refilling the bucket, i.e., the EV's battery, with more energy.

Keep in mind that an EV's battery will lose charge not only due to the miles we drive but also due to driving conditions. An EV's battery might show minimal depletion after driving with light loads, on flat roads, and in warm temperatures. That same EV's battery might show much more depletion after driving the same mileage over hilly areas in cold conditions, with a heavier load, and/or against a strong headwind.

For example, a plug-in EV only has a very small battery because it also has a gasoline engine with its own fuel tank. That means a PEV will charge up relatively quickly even with a Level 1 charger. In a charging speed side-by-side comparison, the EV with the smaller battery will charge faster than the EV with the larger battery, at the same charging level.

### There is one other important variable to consider: the speed at which a given EV can accept a charge.

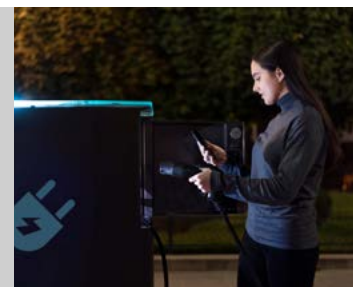
Every EV has a computer system that regulates the battery pack, to ensure the rates of charge and discharge remain at safe levels. This computer function is often called the battery management system, or BMS. The BMS not only manages the charge among the various cells of the battery but also regulates how fast those cells can be recharged. Think of the BMS as being a police officer who is controlling an intersection. Traffic can only move up to a certain speed through the intersection, and only in one direction at a time, to ensure safety.

The BMS performs a similar function by regulating how much electrical charge can come from the charger and how much energy can be directed to the motor. This is also where EVSE comes in. A modern Level 2 charging station is more than just a way to charge EVs faster. That charging station also includes advanced internal systems which further regulate, balance and optimize charge delivery from the electrical service to the EV. This is why it's important to have a certified installer provide a Level 2 charging station, to ensure you are getting the best EVSE for optimal charging.

Older EVs generally have a BMS with slower charging rates and lower tolerance. While that may not make a substantial difference for Level 1 or Level 2 chargers, it is readily apparent with DCFC chargers. Those older EVs may only be able to take a 50kW charging rate, while newer EVs can accept charging rates of 150kW and beyond.

## REAL-WORLD EXAMPLES

Are all these details a little hard to follow? It can be worth reviewing multiple examples, to [compare charging costs](#) across numerous EV models and analyze how charging methods stack up with real-world usage.





# Home Charging vs. Public Charging— What Are the Pros and Cons?

We've explored most of the variables regarding charging levels, including how different EVs make use of the available technology. Next, let's look at how your charging location can impact your charging cost.

## The Advantages of Home EV Charging:

- Home charging is not only convenient, but it is also almost always less expensive. You are being charged only for the electricity you use, without any of the additional fees or subscriptions that are common at public charging stations, where operators are interested in making a profit. [The savings can be striking](#), with EV charging at home equating roughly to paying only a dollar for a gallon of gas for a conventional car.
- Many communities' electrical rates go up and down as demand changes. Often, the cheapest rates and lowest demands are overnight, which is an optimal time for most EV owners to charge their vehicles. Check with your electricity utility to see if you can save money by taking part in a time-of-use plan with tiered rates. Smart panels and smart

charging stations take the guesswork out of this and help EV owners charge their vehicles as cost-effectively as possible. For more information about smart panels and smart charging, [refer to this collection of smart charging articles](#) in the Qmerit Electrification Institute.

- You won't have any competition for an at-home EV charging station unless other members of the family also have EVs. If you do have multiple EVs at home, you can discuss convenient options with your certified installer for charging two or more vehicles simultaneously. There are many resources now available for [charging multiple EVs at home](#) with a professionally installed Level 2 charging station.

## The Disadvantages of Home EV Charging:

- Charging at home is almost always limited to either Level 1 or Level 2 charging stations. Level 3 charging stations require DC service as well as a much more robust wiring infrastructure.





- Charging will take a minimum of at least a few hours, ranging up to 8-12 hours for Level 2 charging and significantly longer for Level 1 charging. In particular, an older EV can require more than 40 hours to recharge a completely depleted battery pack.
- If you own your home, you are responsible for the installation and maintenance of any charging station. Please note: do not try to install a Level 2 charging station as a do-it-yourself project or by hiring someone without the appropriate qualifications. The money you might save initially is vastly outweighed by the safety risks. Please contact a qualified electrical contractor for all your installation needs. For a more detailed description of home charging station safety issues, check out [Tom Moloughney's detailed EV charging video](#).
- If you are a tenant and would like to install a Level 2 charging station, talk to your landlord about installation options. You and/or the landlord have a variety of options for how to proceed, and everyone should be clear on those options and their implications. For more information on this topic, read through this in-depth article on assessing the [pros and cons of installing Level 2 charging stations at multifamily buildings](#).

#### **The Advantages of Public EV Charging:**

- Public chargers are extremely fast since they are usually DCFC stations, but publicly available Level 2 chargers are also important. DCFC stations can recharge batteries within 15-45 minutes rather than 4-8 hours, so charging speeds will depend on the public chargers available near you.
- You may be able to run errands while your EV is charging, easily managing your time.
- Public EV chargers make longer road trips possible, allowing you the freedom and flexibility of not needing to return home each night.

- EV chargers available at your place of business can make a long daily commute more feasible. A depleted battery pack can recharge while you're at work, on lunch, or on break, providing you with a fresh charge prior to your return home.
- Many automakers are now including a subscription to regional or national recharging networks as part of your EV purchase price. These subscriptions usually last 1 to 3 years.

#### **The Disadvantages of Public EV Charging:**

- Public chargers can be fraught with issues regarding reliability and speed of charging.
- Public charging stations may not be well-lit at night and typically do not have human attendants.
- Many public stations are also located in areas far away from buildings and are not protected from the elements.
- DCFC charging stations, while commonly available at most quick-stop locations (such as malls or grocery stores), can cause significant battery degradation over time and should be utilized no more than three times per month when possible. Check out this in-depth [research article about EV battery health](#), published by Geotab.
- Some communities do not have the number of charging stations required to support existing (let alone projected) EV usage, which creates competition for the few EV charging station parking spots that are currently available.
- A public charging station's parking spots will occasionally be occupied by either an EV that is already charged or by an ICE vehicle that doesn't need charging at all. Sometimes this is a simple mistake, while other times it is a deliberate attempt to block EV charging access.
- Most public charging stations assess a fee to connect and/or offer electricity at higher kW





rates, making it considerably more expensive than the cost you would incur at home for using the same number of kWh.

- Various public EV charging networks feature different charging connector types, and they are not interchangeable without an adapter. Before relying on a given public EV charging station, make sure it has a connector that matches your EV. The good news is that connector adapters are now available across a range of EV models, allowing access to a wider array of public charging stations. This [State of Charge video](#), hosted by industry expert Tom Moloughney, provides the latest on the flexibility that adapters can provide.

The bottom line is that home EV charging may take longer, but it costs much less and promotes EV battery health long-term. It is almost always more reliable and will continue to be so for years to come until the public network of charging stations has grown more mainstream and become better maintained.

Home EV charging will offer you the best combination of convenience and affordability both now and for the foreseeable future.

While many EV owners recognize the benefits of home charging, they may understandably hesitate due to the perceived installation cost. Contrary to this belief, research reveals that installing a Level 2 charging station at home will usually pay itself off within just a few years.

When reviewing the [cost-effectiveness of installing your own Level 2 charging station](#), the general rule of thumb is that the more miles you drive your EV per month, the more rapidly a Level 2 home charging station will pay for itself.

If you are a multifamily building owner, you need to consider a number of additional variables, such as ROI, demand, and pricing options. For an in-depth analysis of all these issues, read [this article about installing Level 2 chargers for your residents](#). It will help you decide if this is a smart investment for your property, and how to make the most of that investment.

Need more motivation? The best news is that EV owners have more ways than ever before to reduce the cost of installing Level 2 charging stations through a combination of tax rebates, installation offsets, and other incentives.





# Driving and Charging Habits

While many of the variables we've discussed are determined by the manufacturer, there are several ways that EV owners can increase their cost savings on their own as well, by optimizing personal driving and charging habits. In particular, [taking good care of your EV battery](#) will help extend its life and save you money in the process.



Here are a few easy steps for following EV best practices:

- **Be mindful of your charging speed in relation to the overall cost.** Public charging stations are attractive in terms of their convenience and speed, but you'll end up paying for both. If you need your EV to be as cost-effective as possible, try to charge it at home as often as you can. If the cost of installing a home charging station is the only obstacle, take a look at the current research. A number of studies have concluded that [home charging installations will pay for themselves](#) after only a few years.
  - **No matter your location when charging your vehicle, apply the 80/20 rule as frequently as possible.** That means charging the battery only to 80% (not 100%) and not letting it drop below 20%. This practice will notably extend the battery life, by avoiding the minimum and maximum charge extremes.
  - **Charging regularly with DCFC can lead to battery degradation over time, [dropping total battery capacity to just 60% in only 40 uses.](#)**
- Utilizing Level 1 and Level 2 stations for the majority of your charging needs will thus greatly extend your EV battery life.
- **Future-proof your EV's range by [planning out longer trips](#) and confirming the most suitable charging options along the way.** You may also want to consider other road challenges on your route, including extensive hill climbs or extreme temperatures, which can deplete your battery faster than in less-demanding conditions.
  - **Remember that any battery will lose charge faster, and recharge more slowly, in [cold weather.](#)** The lower the temperature, the more pronounced the effect. Be cautious during your EV's first winter until you learn how your particular battery pack responds to the weather in your area.
  - **Your driving habits can maximize your EV's driving range,** from how you brake and accelerate to where you park.



# What EV Incentives Are Available Right Now?

You have probably heard that government programs and tax rebates can offset EV purchase costs.

What you may not know is that many of these same programs can also help offset home charging station installation costs and, in some cases, even EV charging station purchase costs.



Even if you don't own an EV and simply drive one for your job, there are still incentives that can make it worth your while to install a home charging station.

Let's look at the latest options for federal, state, and local EV purchase programs, tax rebates, and other charging station installation incentives:

- The 2022 Inflation Reduction Act included an amendment that applied to qualified EVs. [Learn more about the "Clean Vehicle Credit."](#)
- The Alternative Fuels Data Center, which is a division within the federal Department of Energy, offers this [comprehensive website](#) of all current federal and state tax incentives, rebates, and other cost-saving programs for alternative fuels and alternative vehicles. The database allows searches based on location, fuel, and/or vehicle type.
- The ElectricForAll website also lists a variety of [federal and state incentives](#). You can search by your ZIP code to see those programs which apply specifically to you.
- If you are a California EV owner, the California Air Resources Board has put together [a state-specific list of incentives, rebates, and programs](#) designed to offset your costs.
- Kelly Blue Book also maintains a list of [EV incentives](#), organized by state.
- Qmerit's website has a number of articles on how to offset the cost of EV ownership and charging. For example, this Qmerit blog post goes into detail about various ways to [offset charging station installation costs](#).



# How to Implement Your Charging Solution

The benefits of EV ownership can be maximized by utilizing home charging stations, optimizing driving and charging habits, and taking advantage of available incentives. As the EV industry continues to grow, the importance of accessible and convenient charging options will only increase, making it a smart investment for both EV owners and building owners alike.

Finding a dependable and qualified electrician for your EV charging project can be a challenge, but

as the most trusted and leading provider of EV charging and electrification installation solutions, Qmerit can help.

Recognized by the [White House](#) for leading the charge, and with years of experience in managing electrification projects for stakeholders across the EV ecosystem, including homeowners, automakers, EV charger manufacturers, and fleet managers, Qmerit makes electrification easy and convenient.



**Contact Qmerit** today to find out how we can simplify your EV adoption and make your energy transition seamless.

