INSTALLING ELECTRIC VEHICLE CHARGING AT HOME

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**About Green Energy Consumers Alliance**

Green Energy Consumers Alliance is a nonprofit that enables people to make green energy choices in the most cost-effective, practical, and seamless ways possible. Our Drive Green program helps drivers go electric through pre-negotiated discounts to purchase or lease, educational resources, advocacy, and test drive opportunities.

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**About this guide**

"Installing Electric Vehicle Charging At Home" is meant to help you navigate the process of installing an electric car charging station at home. While it's a good place to start, it's no replacement for the expertise of a licensed electrician. Please be sure to consult a professional before making any changes to your home's electrical system.
DETERMINE YOUR CHARGING NEEDS

Electric vehicle (EV) drivers tend to do the majority of their charging at home because it’s usually the most convenient option. While it’s common to install Level II (240 volt) charging units at home for faster charging, there are plenty of drivers who get by using just a Level I charge, otherwise known as a “trickle-charge.”

Level I charging uses a regular household outlet and delivers about four miles of range per hour of charging. EVs are sold with a portable charging cord that you can use at home or on the road. Gaining only four miles of range per hour spent charging is pretty slow, but considering all the time your car will spend parked at home, this rate may be enough to support your driving. Before you commit to installing a Level II charging station, ask yourself:

1. **How many miles do I typically drive in a day?**
2. **How often and for how long can I leave the car plugged in?**

If you don't drive very many miles or your car spends lots of time parked at home, Level I charging will meet your charging needs without you having to worry about installing charging equipment at home.
For reference, the average driver travels less than 40 miles a day by car, which means a diligent EV owner who plugs in when they get home can recharge in 10 hours using a regular outlet.

Condominium-owners and renters need the approval of their condo association or landlord to install charging equipment for Level II charging. If you are unable to make upgrades to the electrical system in your home, then you will have to rely on a combination of Level I charging at home and public Level II or fast charging.

If you own your home and are considering installing Level II charging because you're not sure you can make Level I charging work, you can always try relying on it for a couple of weeks before you start the installation process.

According to the experiences of Drive Green participants, range anxiety fades quickly after you develop a regular charging schedule. But if you're still feeling uneasy after a couple of weeks of Level I charging, it's probably best to install a Level II charger at home.

All electric cars except Teslas use the J1772 port (pictured above) for Level I and Level II charging. If you own a Tesla and would like to use a J1772 plug, there is an adaptor that comes with the vehicle.

Public charging stations are often hidden from view; there are probably more than you think where you live. PlugShare is a great resource to find charging in your area.

An additional tip for renters and condo-owners: if you decide to rely on trickle-charging, make sure the outlet you're using is connected to your own electric meter so that you can pay for the electricity you're using.

Read more about EV charging basics at greenenergyconsumers.org/drivegreen/charging
A NOTE FOR APARTMENT AND CONDO DWELLERS

If you live in a building with many units, you may not have the freedom or flexibility to install charging in a private driveway like many single-family homeowners do.

Challenges include:
- Lacking the authority to make electrical upgrades
- Seeking the approval of a homeowners or condo association
- Needing time and resources to make a good case to your neighbors or building owners about why charging stations are a worthwhile investment

Despite the barriers you may face, there is hope! Green Energy Consumers Alliance is developing a guide specifically for apartment and condo dwellers to advocate for charging stations for their multi-unit buildings. Expect a guide by mid-2021.

Good reasons to expect more public charging in the coming years:

1. More incentives for multi-unit buildings to install charging
2. Greater awareness of EVs
3. More demand by residents
GLOSSARY OF EV CHARGING VOCABULARY

As you transition to thinking about electricity as a fuel source for your car and prepare to install a charging station in your home, it's helpful to know some basic terminology related to electricity and electric car charging.

**VOLTAGE** is the difference in electrical potential between two points. It describes how much electric "force" is available to generate electricity. Voltage is measured in VOLTS and is used to describe wall outlets and other power sources.

**CURRENT** is the flow of electricity over time caused when voltage is applied to a load. Most charging stations are rated and advertised by how much current they deliver, which is measured in AMPS.

**ENERGY** is the total available capacity to do work, like recharge or turn the wheels of a car. When talking about electricity, energy is measured in KILOWATT-HOURS (kWh). A typical electric car can travel 3-4 miles per kWh.

**POWER** is energy output over time. Electrical power increases with higher voltage and higher current, and it's measured in KILOWATTS (kW). Higher power means you can charge your EV in less time, but most EVs have a limit that puts a cap on how quickly they can charge using a Level II station.

An **ONBOARD CHARGER** is the device in an electric car that converts AC power from the wall outlet to DC power to be stored in the EV's battery. For Level I and Level II charging, the maximum charging speed is limited by the onboard charger's power.
Electric Vehicle Supply Equipment, or EVSE, is a fancy term for a charging station. All electric cars come with a charging cable that plugs into a regular 120-volt outlet, but if you want to charge at a higher rate, you need:

- a 240-volt outlet
- a cable that connects your car to the outlet, and
- a way to manage the electrical current running between them.

The 240-volt outlet is something that an electrician must install, unless you already have one in your home for a washer or dryer; EVSE covers the second and third bullet points. Electric vehicle supply equipment is the cable and box that makes sure that the car does not draw more current than it can accept or the outlet can deliver, protecting your car and home from surges. EVSE also prevents current from flowing if the charging port and cable are not properly connected, making it essential safety equipment.
Once you've decided you need a Level II charging station, it's important to recognize that different electric models charge at different speeds based on the capacity of the car's onboard charger. Plug-in hybrids (PHEVs) typically have a lower Level II charging rate compared to battery-electric vehicles (BEVs) because their batteries are smaller.

To get the most out of your at-home charging station, make sure you purchase a Level II unit that delivers at least as much power as your EV can accept. For example, if you have a vehicle with a 7.7-kilowatt onboard charger, don't get a charging unit that can only deliver 5 kilowatts! The exception is if you have a PHEV and anticipate purchasing another EV with a higher charging capacity in the future; then you may want to opt for a higher-power charger right away.

**Your car will not charge faster if you buy EVSE that delivers more power than your car can accept.**

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**EV TIP:** You can extend the lifespan of your electric car battery by keeping it between 20% and 80% full most of the time. You can do this by setting your car or charging station's maximum charge level to 80%.

Charging specifications for EVSE vary by EV make and model. To learn how fast your car can charge at Level II, what kind of station you should buy, and the circuit breaker required on your panel to support it, please reference the table on the next page.
# Electrical Specifications for EVSE by EV Model

<table>
<thead>
<tr>
<th>Charging Station Rating</th>
<th>Minimum Recommended Circuit</th>
<th>Onboard Charger Capacity</th>
<th>Maximum Charging Speed</th>
<th>Cars</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 amps</td>
<td>50 amps 240 volts</td>
<td>7.7-10 kilowatts</td>
<td>25-30 miles of range per hour of charging</td>
<td>Tesla Model S, Tesla Model X, Tesla Model 3</td>
</tr>
<tr>
<td>32 amps</td>
<td>40 amps 240 volts</td>
<td>7.4 kilowatts</td>
<td>24 miles of range per hour of charging</td>
<td>BMW i3</td>
</tr>
<tr>
<td>30 amps</td>
<td>40 amps 240 volts</td>
<td>6.6-7.2 kilowatts</td>
<td>22-24 miles of range per hour of charging</td>
<td>Nissan LEAF, Chevrolet Bolt, Hyundai Kona EV, Kia Niro EV, Volkswagen eGolf, Hyundai Ioniq EV, Chrysler Pacifica, Honda Clarity PHEV</td>
</tr>
<tr>
<td>16 amps</td>
<td>20 amps 240 volts</td>
<td>3.3-3.7 kilowatts</td>
<td>11 miles of range per hour of charging</td>
<td>Toyota Prius Prime, Honda Clarity PHEV, Mitsubishi Outlander PHEV, Kira Niro PHEV</td>
</tr>
</tbody>
</table>

**CHARGING STATION RATING:** what the EVSE is advertised as  
**MINIMUM RECOMMENDED CIRCUIT:** the circuit breaker you'll need in your panel  
**ON-BOARD CHARGER CAPACITY:** the maximum power an EV can accept while charging  
**MAXIMUM CHARGING SPEED:** how many miles of range you get per hour of charging  
**CARS:** the vehicles on the market that meet the listed specifications

If you're interested in a vehicle that's not listed here, simply look up its onboard charger capacity to find the appropriate charging station rating and minimum recommended circuit.
FEATURES TO LOOK OUT FOR

There are over 50 EVSE vendors with hundreds of available models of charging stations to choose from. Here are some common features for you to consider as you think about which unit is right for you.

- **AMPERAGE.** Charging stations that deliver less power do so because they draw less current. Take advantage of your car's maximum charging rate by buying a station with the appropriate amperage. Check out Page 8 to find the electrical specifications for different EV models.

- **CONNECTIVITY.** When EVSE is “smart,” it means that it can communicate with other internet-enabled devices. That means you can monitor energy consumption, charging rate, and other data about your charging behavior remotely from a smartphone. Just make sure your Wi-Fi reaches your parking space!

- **SCHEDULING.** “Smart” EVSE allows you to schedule charging from a smartphone. While many car models already accommodate scheduling, smart EVSE allows you to schedule charging remotely or according to price signals from the utility. For example, Eversource has a demand-response program that provides a financial incentive for people who are willing to slow their charging rate during high-demand periods. Participating in programs like this can help offset the cost of installation.

- **FOOTPRINT.** How much physical space do you have for the charging box? Many models of EVSE are meant to be mounted on a wall, so you have to consider the space the box will take up if your garage or parking space is tight.

- **CORD LENGTH.** You need to be able to plug in from wherever the EVSE is mounted. You cannot replace a cable that’s too short with a longer one without buying an entirely new EVSE. Consider where the cable will be hanging when you charge and if it will block any important walkways. 25 feet is the maximum allowable length for EVSE cords.
• **PORTABILITY.** If you often leave your car parked at different homes or anticipate moving, you may want to consider buying a portable charger. These are not designed for wall-mounting, but can be plugged in and used wherever there is a 240-volt outlet.

• **SAFETY.** Make sure the EVSE you buy is UL-listed and/or verified to be safe by an independent laboratory. Otherwise, there’s no reliable way to know that the high-voltage equipment that you’re purchasing is safe to install in your home.

• **PLUG-IN/HARDWIRE.** Some EVSE must be installed directly to your electrical panel, others can simply be plugged in to a 240-volt outlet. If you know you need to install your charging station outdoors, it will need to be hardwired, but otherwise, choosing a plug-in model is easiest.

Wondering where to start? Here are two EVSE buying guides that list some of the most popular brands and models.

*InsideEV’s Ultimate Buyer’s Guide To Home EV Chargers: Plus Top 5 Picks*

*CarBibles’ The Best Home EV Chargers (Review & Buying Guide) in 2020*
WHY GO WITH A "SMART" CHARGING STATION?

Basic models of Level II EVSE are just a plug with a circuit breaker. These models are the cheapest, but also give you almost no control over the car's charging rate. Other EVSE models are more expensive, but they can collect data on your charging habits, manage/schedule charging, and help you monitor your car's charging from your smartphone.

Such features can be useful because the wholesale price of electricity varies throughout the day, depending on how much energy is needed on the electrical grid at a given time. Many utilities are starting to implement time-of-use (TOU) rates to more closely match the price that consumers pay to the cost of delivering electricity. By managing an electric car's charging as a response to TOU price signals in these programs, an EV driver can save even more on fuel costs and help contribute to the overall reliability of the grid.

Modern EVs, such as the Nissan LEAF, Chevrolet Bolt, and Hyundai Kona, have charging schedulers built into the dashboard, as shown above. But if you'd like to have more advanced options to manage your charging, smart EVSE is the way to go.
CONTACT AN ELECTRICIAN

Depending on the type of charging equipment you want and how ready your home is to support the additional electrical load, installing a charging station typically costs around $1,200 for both the station and the electrician's labor.

If you already have a 240-volt outlet where you'll be charging and you know your home's panel can handle the additional load, good news - you can go ahead, purchase a charging station, and hire an electrician to perform a fairly easy and inexpensive installation. Any licensed electrician should be qualified to install a charging station, but the more experience the electrician has, the smoother your installation will be.

It’s a good idea to reach out to multiple electricians and invite at least one to take a look at your electrical system so that you can get an accurate quote. Depending on the status of your home's electrical panel and the location of your installation, your home's electrical system may need upgrades to make it possible to support an EV. The next page lists some common factors that may affect the total installation cost of your charging station.
FACTORS THAT AFFECT COST OF EVSE INSTALLATION

- **OUTDOOR INSTALLATION.** If you have indoor space available, installing EVSE in the garage will protect your equipment and make for a cheaper installation. The closer to the electrical panel, the better. If you must install EVSE outdoors, it will have to be permanently hardwired into your electrical panel. You may want to consider installing a protective enclosure, too.

- **HARDWIRE INSTALLATION.** An electrician can hardwire EVSE to your electrical panel to make it permanent, but it's best to avoid this if you can. The most straightforward and cheapest way to install EVSE is to upgrade an outlet to 240-volts, plug in the EVSE, and mount it on a wall. Plug-in installations make it more convenient to remove the EVSE, especially if you have a problem with it in the future.

- **PANEL LOCATION.** If your electrical panel is not in your garage, the electrician will have to run a conduit from the panel to where you'll be charging.

- **CURRENT CAPACITY.** Many older homes draw only 100 amps of current. To be able to meet the demand of all your household appliances and your new EV charger, your home will need a 200-amp panel before you can install EVSE.

- **ELECTRICAL PANEL SPACE.** If all the circuit breakers on your electrical panel are wired up, then you don't have room for EVSE. An electrician will have to install a sub-panel to make room for the equipment.

Although installing a charging station can carry a large upfront cost, you'll make up the difference in fuel savings. Plus, there are incentives and programs available to further decrease your charging costs! See the next page.
REBATES, INCENTIVES, AND
UTILITY PROGRAMS

FEDERAL TAX CREDIT FOR EVSE. Consumers who purchase an EV charging station for their home before December 31, 2021 are eligible for a federal tax credit covering 30% of their installation costs, up to $1,000. Learn more at https://afdc.energy.gov/laws/10513 or by searching "Alternative Fuel Infrastructure Tax Credit."

Be sure to check your electric utility's website for programs designed for EV owners to decrease your equipment costs, your charging costs, or both. These programs generally come in two flavors:

EV HOME CHARGER DEMAND RESPONSE. During moments of extreme stress on the electricity system, the utility can make adjustments to decrease your charger's energy use. You will still be able to charge your electric vehicle, but you'll help decrease the strain on the electric system.

For example, Eversource offers a $300 incentive for enrolling in demand response program to help you buy a pre-approved charging unit to participate. If you already own an eligible charging unit, you may receive $150 for signing up.

OFF-PEAK CHARGING REWARDS. Nighttime is the best time to charge your electric car. Many utility companies are offering programs to reward you for charging when it's least polluting and least costly to the system. You get paid for the energy you consume during "off-peak hours."

For example, National Grid offers a "Smart Charge Rewards" program in both Massachusetts in Rhode Island to reward drivers for off-peak charging. Although enrollment for this pilot program is full, more options are on the way.
As you move through the process of installing a charging station in your home, here are some questions you will want to ask yourself.

- Do I need a Level II station to support your driving?
- Can I make decisions about making changes to your home's electrical system?
- If you own a condominium or rent, do I have permission from a landlord or homeowner's association to install a charging station or use a public outlet?
- How much power should my charging station output to maximize your car's charging rate?
- Have I reviewed charging incentives and programs from my utility company?
- Are there special features I want to manage my charging remotely or will a basic model of EVSE do?
- Do I have room in your garage or near my circuit breaker to install and mount a charging station?
- If you plan on installing your station outside, is there space where I park to mount the station?
- How long should your cable be to reach my car from the station?
- If you want a "smart" charging station, will my home's Wi-Fi reach the station?
- Does my home have the electrical capacity to support a charging station?
- Are there any upgrades necessary for my home's electrical panel to support a charging unit?
- Do I have a quote from a licensed electrician about the cost of the work?
- Will the electrician handle permitting for any electrical upgrades? Does the quote include permit costs?