



A GUIDE TO

Installing EV Charging at Single-Family Homes

GREEN ENERGY CONSUMERS ALLIANCE

ABOUT GREEN ENERGY CONSUMERS ALLIANCE

Green Energy Consumers Alliance is a nonprofit organization with a mission to speed the transition to a low-carbon future through consumer choices and advocacy. With seven programs, we harness the collective power and interests of people and providers to make green energy the smartest and most seamless choice for homes and communities.

Our Drive Green program helps drivers learn all about electric cars and connect with local dealers to make the switch.

ABOUT THIS GUIDE

Installing EV Charging at Single-Family Homes is meant to help you navigate the process of installing an electric car charging station at home (we have resources dedicated to renters and condo dwellers [on our website](#)). 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.

Included in this guide:

- How to determine your charging needs
- EV charging vocabulary
- Electric vehicle supply equipment (EVSE)
- How to pick a charging station unit
- Electrical specifications for EVSE by car model
- Features to look out for
- Benefits of a "smart" charging station
- Factors that affect the cost of installation
- Rebates, incentives, and utility programs

DETERMINE YOUR CHARGING NEEDS

Electric vehicle (EV) drivers do 80% of their charging at home because it's the most convenient option for many people. 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. Most EVs are sold with a portable charging cord that you can use at home or on the road. Gaining four miles of range per hour spent charging is pretty slow, but considering the time your car will spend parked at home, this rate may be enough to support your driving. Before you commit to opting for 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 much or your car spends lots of time parked at home, Level I charging will meet your needs. You don't have 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.

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!

Condominium owners and renters need the approval of their condo association or landlord to install charging equipment for Level II charging. We have resources dedicated to renters and condo dwellers [on our website](#)! 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 few 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. If you're still feeling uneasy after a trial period of Level I charging, it's probably best to install a Level II charger at home.

EV CHARGING VOCABULARY

As you transition to thinking about electricity as a fuel source for your car and prepare to install charging equipment for your home, it may be helpful to know some basic terminology related to electricity and EV charging.

VOLTAGE

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

The flow of electricity over time that's caused when voltage is applied to a load. Most charging stations are rated by how much current they deliver, which is measured in amps.

ENERGY

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).

POWER

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.

ONBOARD CHARGER

The device in an electric vehicle 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 (EVSE)

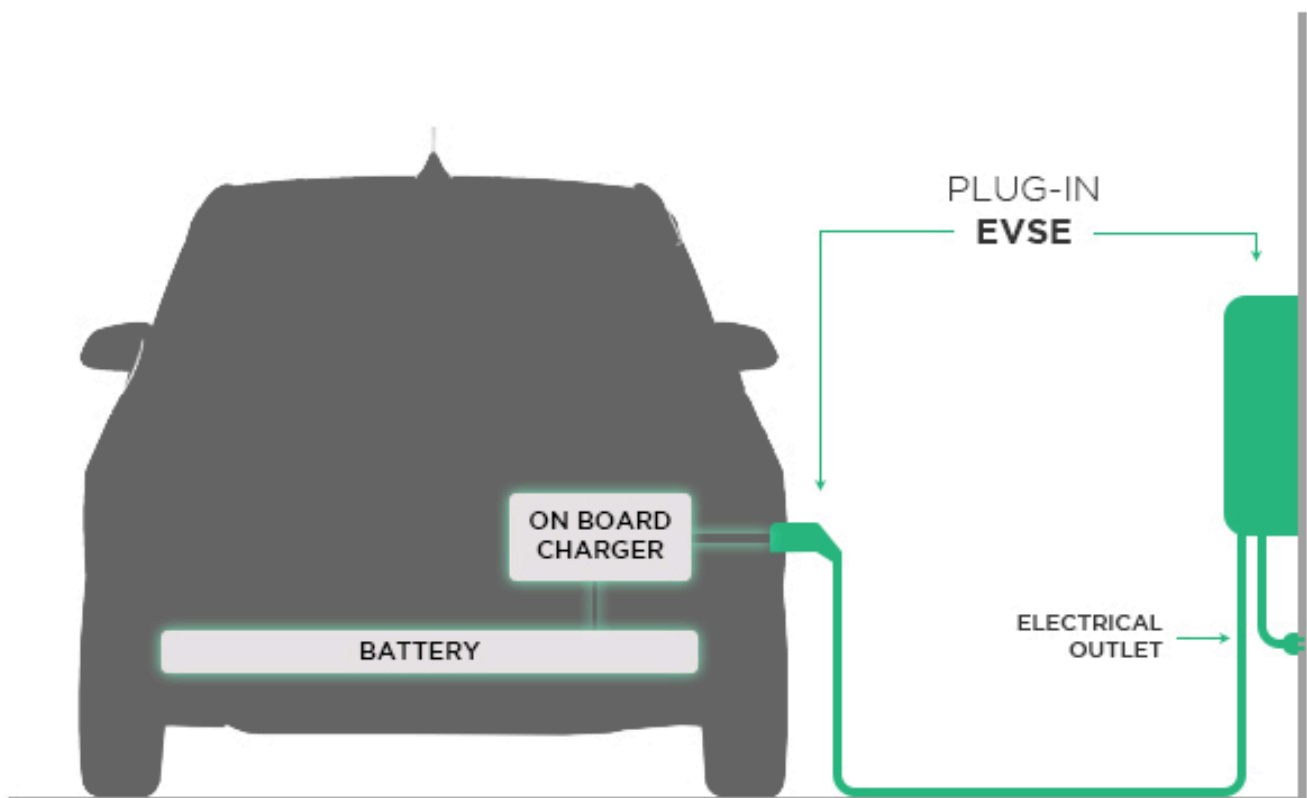
Electric Vehicle Supply Equipment, or EVSE, is a fancy term for a charging station. Most electric cars come with a charging cable that plugs into a regular 120-volt outlet, but if you want to charge at a higher rate, you need:

- A 240-volt outlet
- A cable that connects your car to the outlet
- 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.

EVSE is safety equipment that protects your car and home from surges: it prevents the car from drawing more current than it can accept or the outlet can deliver or current from flowing if the port and cable are not properly connected.

There are two basic Level II options. (1) Get a portable Level II charger, which is essentially a reinforced cord that plugs into a 240-Volt NEMA outlet on one end and a vehicle on the other. (2) Have an electrician install EVSE in your home, which essentially looks like a box and cable attached to a wall, as illustrated in this image.



HOW TO PICK A CHARGING STATION UNIT

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 hybrid vehicles (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!

If you have a PHEV and anticipate purchasing another EV with a higher charging capacity in the future, you may want to opt for a higher-power charger right away. But note that your EV will not charge faster if you buy EVSE that delivers more power than your car can accept.

You can extend the lifespan of your EV battery by keeping it between 20% and 80% full most of the time. Just set 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

As explained above, electric vehicles have onboard chargers that convert the AC power from your wall outlet to DC power the battery can use. The kW rating of the vehicle's onboard charger will tell you how fast your vehicle can charge. If you want to charge at the fastest Level 2 rate possible, you'll want to purchase EVSE that can deliver power at that same rate. (For example, if you purchase a vehicle that can charge at 11.5 kW, you'll want to opt for EVSE that can output power at or close to 11.5 kW (a 7.7 kW EVSE will charge your vehicle more slowly).) This table will tell you, based on the power delivery you're looking for, what amperage you'll need. You can use this information to talk to your electrician and see how much more load your circuit can accept. The table will also give you a sense of how many miles of range you'll get per hour charging at each level of power delivery.

CIRCUIT BREAKER (amps)	MAXIMUM OUTPUT (amps)	POWER DELIVERY @240V (kW)	MILES OF RANGE ADDED (per hour)	MILES OF RANGE ADDED (overnight)	APPROX. kWh ADDED (overnight)
100	80	19.2	35 - 75	350 - 750	175
60	48	11.5	20 - 45	200 - 450	105
50	40	9.6	18 - 38	175 - 375	85
40	32	7.6	15 - 30	150 - 300	70
30	24	5.7	11 - 22	100 - 220	50
20	16	3.8	7 - 15	70 - 150	35
15	12	2.8	5 - 11	50 - 110	25

Table source: State of Charge

Look up the onboard charger capacity for the electric cars you're interested in to find the appropriate charging station rating and minimum recommended circuit.

FEATURES TO LOOK OUT FOR

There are over fifty 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 7 to find the electrical specifications for different power levels. You can use our Drive Green [shopping tool](#) to identify the Level 2 charging capability in kW for any EV on the market.

CONNECTIVITY

When EVSE is “networked,” it can communicate with other internet-enabled devices. You can monitor energy consumption, charging rate, and other data about your charging behavior remotely from a smartphone, and participate in utility smart charging programs.

SCHEDULING

“Smart” EVSE allows you to schedule charging from a smartphone. While many car models already accommodate scheduling through the vehicle dashboard and/or through an app, smart EVSE allows you to schedule charging remotely.

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 purchase 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 into 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? Check out these buying guides:

- [*Everything You Need to Know About Charging an EV at Home*](#)
- [*Best Home EV Chargers for 2023, Tested*](#)

WHY GO WITH A "SMART" CHARGING STATION?

Basic models of Level II EVSE are simply plugs 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 across the country 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. So far, our utilities in Massachusetts and Rhode Island are behind the curve. As of May 2023, only [National Grid has an off-peak charging program](#), which you can participate in either through vehicle telematics or one of a list of approved smart chargers.

Most modern EVs have charging schedulers built into the dashboard or even allow you to schedule charging via an app on your phone. But if you'd like to have another option to manage your charging, a smart EVSE is a good idea.

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 between \$600 and \$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. There is EVSE that is specifically built to withstand the elements outdoors.

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.

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.

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.

REBATES, INCENTIVES, AND UTILITY PROGRAMS

FEDERAL TAX CREDIT

The Inflation Reduction Act (IRA) extends, until 2032, the Alternative Fuel Infrastructure Tax Credit. Consumers who purchase an electric charging station can receive a 30% tax credit, up to \$1,000. However, to qualify, the equipment must be installed in a location that meets the following census tract requirements, per the IRA (these three bullets are taken directly from this AFDC page):

- The census tract is not an urban area;
- A population census tract where the poverty rate is at least 20%; or
- Metropolitan and non-metropolitan area census tract where the median family income is less than 80% of the state medium family income level.

We are waiting for guidance from the Treasury/Internal Revenue Service on how to determine which census tracts meet these requirements. We hope to update this resource with a tool to help you determine your eligibility!

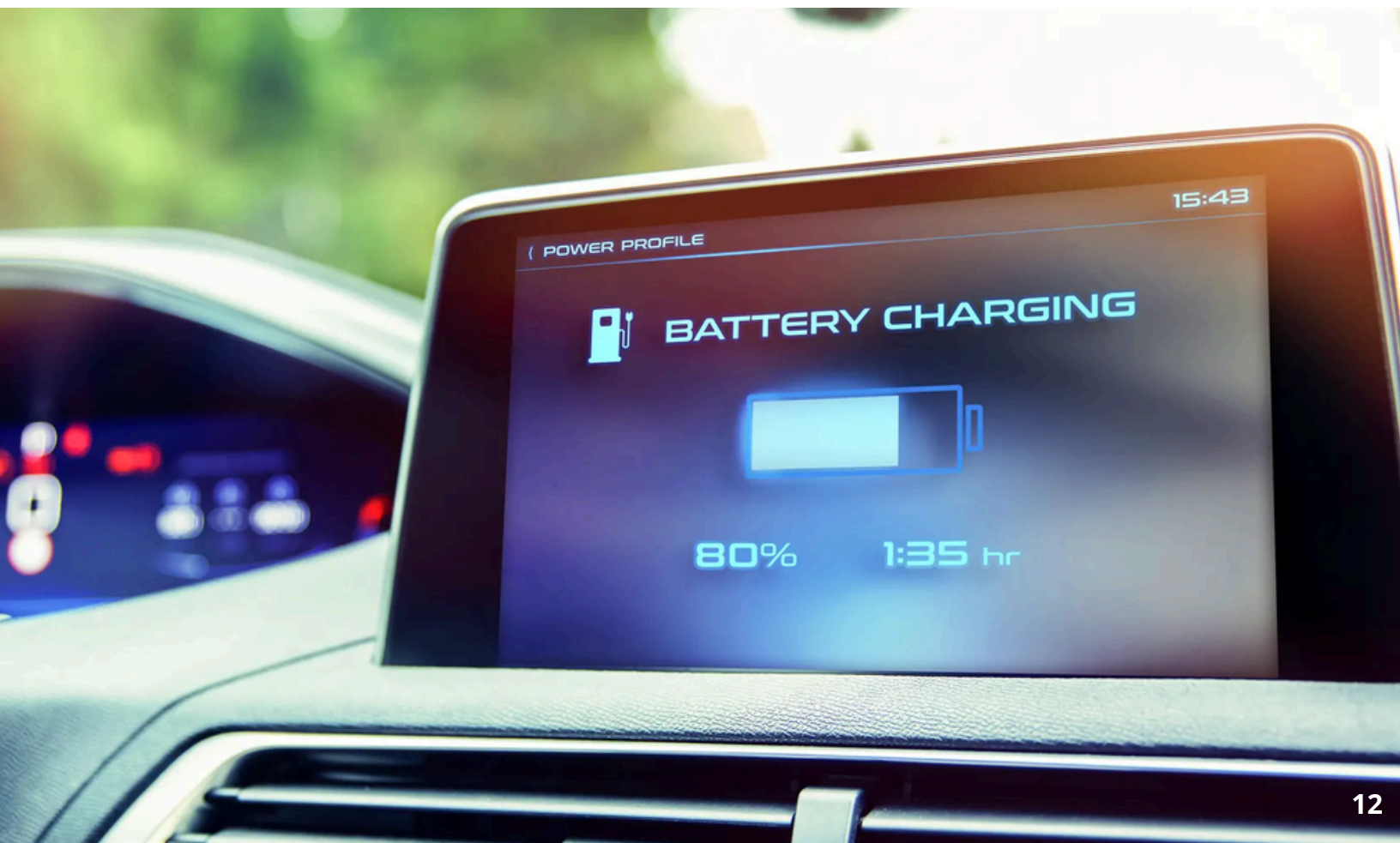
MASSACHUSETTS INCENTIVES

If you are a resident of Massachusetts and get your electricity delivered by a municipally owned utility or Unitil, please check your delivery company's website for information on their electric vehicle programs (you can also [email ev@unitil.com](mailto:ev@unitil.com)). If you are a customer of National Grid or Eversource, you qualify for different incentives based on your income and location:

- If you are on the utility's low-income electricity rate, you qualify for a rebate of up to \$1,000 for wiring upgrades and up to \$700 for the purchase and installation of a home charger. To qualify, you must enroll in any available managed charging program.
- If you are not on the utility's low-income electricity rate but live in an environmental justice community, you qualify for a rebate of up to \$1,000 for in-home infrastructure upgrades but NO rebate for the purchase and installation of a home charger. To qualify, you must enroll in any available managed charging program.
- If you are neither on the utility's low-income electricity rate nor live in an environmental justice community, you qualify for a rebate of up to \$700 for in-home infrastructure upgrades but NO rebate for the purchase and installation of a home charger. To qualify, you must enroll in any available managed charging program.

To apply for your incentives:

- National Grid - [National Grid's EV Hub](#) or email EVnationalgrid@nationalgrid.com
- Eversource - [Charging Station Program](#) or email EversourceMAEVsupport@clearesult.com



RHODE ISLAND INCENTIVES

If you are a Rhode Island resident, and own or lease a battery electric vehicle or plug-in hybrid electric vehicle registered in the state, you may qualify for a rebate on the installation of an EV charger. The incentives outlined below are distributed by the Office of Energy Resources and the Rhode Island Infrastructure Bank.

- If the installation of an EV charger does not involve upgrades to the electrical system, you qualify for a rebate up to \$350 or 50% of the purchase of a Level 2 residential EV charger, whichever is lesser.
- If the electrical system does require an upgrade to install the charger, then you qualify for a rebate up to \$700 or 50% of the purchase and installation costs of a Level 2 residential charger, whichever is less.
- If you are enrolled in a federal/state income-qualifying programs or your income is under a certain limit based on your household size and the installation of a charger does not require upgrades to your electrical system, you qualify for a rebate up to \$500 or 75% of the of the purchase of a Level 2 residential EV charger, whichever is lesser.
- If you meet those same income requirements and the installation requires upgrades to your electrical system, you qualify for \$1,000 or 75% of the cost to purchase and installation of a Level 2 residential EV charger, whichever is lesser.
- Review applicant and charger eligibility, terms and conditions, and how to apply [here](#).