

 SOLAR UNITED NEIGHBORS

# EV Charging Guide



# WHAT'S IN THIS GUIDE?

<b>WHAT IS SUN AND WHY ARE WE TALKING ABOUT EV CHARGING</b>	<b>3</b>
<b>THE BASICS OF EVS</b>	<b>5</b>
<b>CHARGING YOUR EV – AT HOME AND AWAY</b>	<b>8</b>
<b>TYPES OF EV CHARGERS</b>	<b>10</b>
<b>HOW MUCH TIME DOES CHARGING TAKE?</b>	<b>12</b>
<b>CHOOSE AN EV CHARGER</b>	<b>14</b>
<b>TYPES OF CONNECTORS</b>	<b>16</b>
<b>SMART CHARGING, HOME AND AWAY</b>	<b>17</b>
<b>USING A SMART EV CHARGING STATION</b>	<b>19</b>
<b>THE ECONOMICS OF EV CHARGING</b>	<b>20</b>
<b>INCENTIVES FOR EVS AND EV CHARGERS</b>	<b>22</b>
<b>HOW EVS HELP THE ELECTRIC GRID</b>	<b>25</b>
<b>READY TO GET AN EV CHARGER? WE CAN HELP</b>	<b>26</b>





## WHAT IS SOLAR UNITED NEIGHBORS (SUN) AND WHY ARE WE TALKING ABOUT EV CHARGING?

**SUN is a national nonprofit that helps people go solar, join together, and fight for their energy rights.** We're not a solar company. We don't sell or install solar panels, electric vehicles (EVs), or EV chargers. Instead, we're an organization that helps people navigate the world of solar, with vendor-neutral guidance and resources (like this guide).

**Solar and EVs go together like peanut butter and jelly.** So, what kind of solar rights advocates would we be if we told you about peanut butter but not jelly? In our solar co-ops — buying groups that help people go solar — we almost always give members the option to get EV chargers, too, with or without solar. (If you're wondering how these co-ops work, jump to page 26.)

**Solar owners love EVs, and EV owners love solar! Some people want just solar panels or an EV charger, but a lot of people want both.** Many people like the prospect of being able to power their homes and their cars with homegrown solar energy. This prospect is becoming appealing to more and more people, as EVs continue to improve and become more affordable. In fact, roughly half of consumers who have solar or EV technology have both.

**And guess what. We love both, too!** EVs offer many benefits to their owners. Beyond that, we love them for their energy efficiency and power to strengthen our country's electric grid (with help from wind and solar).



## **You're probably wondering: "Should I get an EV if I can't get solar?"**

Our answer is a resounding "Yes!" Owning an EV has many benefits on its own, solar or no solar. We'll talk about those in the next section. First, let's address the "can't get solar" part of this question.

As an organization that advocates for solar rights, SUN fights to make sure everyone has access to solar. This is true even if you rent your home or live in a home where you can't install solar panels (like a condo, or a house with a roof that's too shaded). If that's you, do yourself a favor and look into community solar. Community solar enables people to pay for a "share" of a solar array (a set of solar panels) out in your community - like on farmland, for example. You get a credit on your electric bill each month for the energy produced by your share. We've got a handy guide to community solar at: [www.solarunitedneighbors.org/go-solar/community-solar/](http://www.solarunitedneighbors.org/go-solar/community-solar/).

# THE BASICS OF EVS:

*To understand vehicle charging, you need to know a little something about electric vehicles (EVs) themselves. We're here for ya.*

## **ELECTRIC VEHICLE (EV) NOUN**

An EV is a vehicle powered by one or more electric motors for propulsion, rather than (or, sometimes, in addition to) burning gasoline. The electricity is stored inside a battery. Plugging the battery into an EV charger recharges it.

There are many types of EVs available in the U.S. Later, we'll talk about how to know which one you need. You can also find reviews by auto industry veterans and professional journalists at [Green Car Reports](#).

## **THREE MAIN TYPES OF EVS**

1. Hybrid electric vehicles (HEV): also known as "hybrids." This type has both a gas engine and a battery. The battery is charged both by the gas engine as well as by the driver's use of the brake pedal, the battery gets a little recharge. You've probably heard of the Toyota Prius. That's probably the best known HEV.
2. Plug-in hybrid electric vehicles (PHEV): Not to be confused with HEVs, this type of EV has both a gas engine and a battery. You recharge its battery via the engine, by regenerative braking, or by plugging it into an EV charger. The Chevy Volt and Chrysler Pacifica are examples of PHEVs you may have heard of.
3. Battery electric vehicles (BEV): These cars run solely on rechargeable batteries. They don't have internal combustion engines. They don't take gasoline. The Tesla Model 3 and Nissan LEAF are two examples.

# WHY PEOPLE ARE CHOOSING EVS

*There's a reason EVs are quickly replacing gas and diesel vehicles. Actually, there are lots of reasons:*



EVs are becoming more and more affordable. The lowest base price\* for an EV is \$20,875 (for a 2022 Nissan LEAF). Pre-owned EVs can offer even better pricing. View a range of prices for EVs [here](#). The average non-luxury car price in [late 2021](#) was \$43,000. Also, EV owner save about [60% annually](#) on average when using electricity over gas to power their cars.



EVs are often lower maintenance than gas-fueled vehicles. [Recent data](#) shows that EVs cost 50% less to maintain and fuel.



The range that EVs can handle with one charging keeps increasing. The range varies greatly, from 59 miles to 400+ miles, with the average being 193 miles ([shown here in kilometers](#)).

\*Base price equals MSRP (manufacturer's suggested retail price) plus destination charge if known (the dealership's delivery cost) minus the federal tax credit if applicable.



▶ EVs are more energy efficient. Gas vehicles use only a small portion of their power — wasting most of it as heat. EVs, on the other hand, put almost all of their power into motion and can regenerate or charge their batteries when braking. EVs get you where you need to go without waste.

▶ EVs reduce carbon emissions. [Use this free tool](#) to see how much you're reducing your carbon footprint by driving an EV.

▶ EVs make our country's electric grid stronger (with help from wind and solar). Energy sources like solar power are created locally and owned by a wide variety of people and companies. Plus, thanks to a new technology called Vehicle-to-Grid (V2G), we'll soon be able to harness battery power from parked EVs. This will bring even more renewable energy onto the grid. More on this later.

**EVs can be powered by the sun. Solar panels allow you to charge your EV with clean, home-made energy.**



# CHARGING YOUR EV — AT HOME AND AWAY

## HOME CHARGING

### **“Say Watt?! I can charge my car at home?”**

*That's right, friend. Most people who own EVs charge them at home, or even at work. An EV charger can be installed in your garage, next to your driveway, or anywhere in or near your house that can accommodate it.*

*At-home EV chargers range in size, but none of them take up much space. There are portable versions that you can carry around in a bag or in your trunk and plug into any regular outlet. There are wall-mounted chargers, probably the most common. And there are chargers with stands you can mount outdoors, like next to your driveway or carport.*

### **When deciding where to put your EV charger, consider these factors:**

- EV chargers need to be connected to your power supply. Make sure the cord can reach from the source of power to where the car will be parked.
- Some chargers have lights on them so they're easier to find and operate in the dark.
- Many EV chargers have locking mechanisms to prevent theft.



# CHARGING YOUR EV AWAY FROM HOME

If you're away from your home for an extended period, like on a road trip, you can still charge your EV.

If you're out on the road or need a public charging station, you can find them more easily than ever. You may be able to find a charging station on the highway. Many hotels, restaurants, and tourist attractions also offer slower charging stations.

We'll get into how long charging takes in the next sections. For now, know that you can find fast charging stations on the road using these websites: [Charge Point](#), [PlugShare](#), [ChargeHub](#), or [A Better Routeplanner](#). If you're driving a Tesla, note that they have a proprietary charger. Use [the Tesla website](#) to find a charging station near you.



# TYPES OF EV CHARGERS

There are three levels available for EV charging: 1, 2, and 3.

Before we get too far into EV charging, one quick but important note about terms:

We use the term “EV Charger” because it’s much more common. But, “Electric Vehicle Supply Equipment” (EVSE) is the technically correct term. The circuitry that determines the battery’s maximum charge rate is actually inside the EV, not in the so-called charger. The EVSE ensures that power is delivered to the vehicle’s battery in a standardized, safe manner and that the charging stops quickly if there’s ever a problem.

Tip: Use the term EVSE when looking up local rebates or discounts on your taxes, or when trying to impress at parties.

## Level 1 chargers

These are the most accessible but also the slowest and least powerful EV chargers. Most EVs on the market come with a level 1 charging cord. You can plug it into a standard household electrical outlet (120-volts). They’re typically used for overnight charging, for EVs with smaller batteries, or where installation of more powerful chargers isn’t feasible.



## Level 2 chargers

Level 2 chargers are the most common. Sometimes called destination chargers, they charge 3–6 times faster than level 1 chargers, powering up an EV in eight hours or less. They require a 240-volt plug (like your clothes dryer) and can be installed in your garage, on the side of your house, or on a pedestal mount by your driveway. (You might also see level 2 chargers in business parking lots.)

A level 2 charger is a great option if you want to charge your vehicle faster than a level 1 charger will allow, if you have a longer than average commute, or if you have an EV with a large battery.

Unlike level 1 chargers, level 2s must be installed by a professional electrician. This is to ensure both safety and code compliance. Depending on your home's electric service, it's possible (though not likely) you'll need an electrical upgrade. Level 2 charging typically requires a 20-amp or greater circuit, with 30–50 amps being the most common.

## Level 3 chargers

Also called DC Fast Chargers (DCFC), level 3 chargers are the least commonly used for homes or businesses. They're super fast but require costly, robust electrical infrastructure. You're more likely to see a level 3 charger in a public (commercial) charging station.



# SPEED MATTERS: HOW MUCH TIME DOES CHARGING TAKE?

Now that you know the three levels of charging, you know that the higher the level, the faster it charges. Here's a handy chart that breaks it down:

Category of EV Charging	Volts & Power (kW)	Charging Time*
Level 1	120 Volts AC 1.3 - 2.4 kilowatts (kW)	3-6 miles of charge per hour
Level 2	240 Volts AC 3 to 20 kW, typically 6	10-40+ miles of charge per hour
Level 3	50-350 kW	75-200+ miles of charge per 30 mins

\*Charging time depends on vehicle type, weather conditions, and driving

Source: <https://chargehub.com/en/electric-car-charging-guide.html>



Charging speed is also dependent upon:

- The vehicle itself and the maximum power it allows for
- The size of your battery
- The amount of charge in the battery when you start charging it (it can be faster to charge a battery from 40% to 80% than from 80% to 100%)

The smallest plug-in hybrid batteries have a range of about 11 miles per charge.

The largest fully electric batteries can go more than 400 miles between charges.

## Examples of charging speeds

Example 1: A Chrysler Pacifica plug-in hybrid can run 33 miles on its battery.

With a level 1 charger, you can fully charge it in 5-6 hours.

With a level 2 charger, it would only take 1-1.5 hours.

Example 2: A Tesla Model 3 Standard Range can go 250 miles on a charge.

With a level 2 charger, you can charge it to 80% in 6 hours (depending on the charger's amps).

With a level 3 charger, it would only take 1 hour.



# CHOOSING AN EV CHARGER

*Here are a few considerations to keep in mind when choosing which EV charger is right for you:*

## **Compatibility**

Make sure your EV charger is compatible with your EV. Most level 2 chargers have a universal plug (J 1772) so any EV can plug into them. Tesla is the exception. Tesla EVs have their own type of charging port and need to be used with a Tesla charger. You can also buy an adapter, which costs between \$50 and \$150.

## **Cord length**

You'll need a cord that's long enough to reach your EV without creating a tripping hazard.

## **Warranty**

Consider whether you want a warranty and how long you want it to apply.

## **Solar**

If you're also a solar owner (or want to be), you could have your EV charger installed at the same time as your solar system. That could save you both time and money. [Note that some EV chargers are standalone. Others work directly as part of a solar array.]



# How much solar does it take to charge an EV?

If you want to install a solar system that will fully charge your EV, you'll want to make sure the solar array is sized to produce enough electricity for both your home and your car.\*

The solar capacity needed to power an EV depends on a variety of factors:

- How many miles you drive annually
- Your vehicle's mileage per kWh
- The amount of energy (in kWh) needed to power the distance covered by your vehicle each year

*\*Note that in some places, the allowable size of a new solar system may be limited based on your previous year's electricity usage. Be sure to check your state and local regulations.*

## How much solar do I need to charge my EV?

In general, without accounting for your household electricity usage, this chart can help you figure out how big a solar array to get to power your EV:

<b>Miles Driven Annually</b>	<b>Solar Capacity</b>
3,500	1 kW
7,000	2 kW
10,500	3kW
14,000	4kW
17,500	5kW
21,000	6kW

These figures are based on conservative estimates and using the following assumptions:

- Mileage of 3.5 miles per kWh
- ~15% AC to DC conversion loss for charging
- A solar system that annually produces 1,200 kWh per 1kW of solar panels

Note that these numbers don't take into account specifics like your household electricity usage.

## Solar or EV charger? Where to start

If you can only install one or the other — a solar system or an EV charger — which should you choose first?

We recommend starting with solar. Solar will save you money on your electric bills, give you energy independence, and reduce pollution. And if you drive your EV infrequently or cover short distances each day, you can make do with the level 1 charger that came with your car until you can install a faster charger at your home.

**Check out our detailed guide to sizing solar for your electric vehicle at:**

[solarunitedneighbors.org/solarsize-EV](https://solarunitedneighbors.org/solarsize-EV)

# TYPES OF CONNECTORS

When considering what type of charging equipment you want for your home, it's important to understand the components. You'll likely discover there are several types of connectors. Not all charging stations and charging equipment support all types of connectors.

**Here are some common connector models:**



**Charging Level 2  
(Fast Charging)**

**Compatibility:  
All EVs**

Connector Model: SAE Port J1772



**Charging Level 3  
(Fast Charging)**

**Compatibility:  
Various EVs – Check**

Connector Model: CCS Combo



**Charging Level 3  
(Fast Charging)**

**Compatibility:  
Various EVs – Check EV**

Connector Model: SAE Combo CCS



**Charging Level 2  
(Fast Charging)**

**Compatibility:  
Only Tesla**

Connector Model: Tesla HPWC9 (Type 1)



**Charging Level 3  
(Fast Charging)**

**Compatibility:  
Only Tesla**

Connector Model: Tesla HPWC9 (Type 1)

# SMART CHARGING—AT HOME AND AWAY

EV chargers with no ability to connect to the Internet are commonly referred to as “dumb chargers.” Smart chargers, on the other hand, enable you to communicate with your charger remotely through a website or an app on your smartphone.

## Home smart charging

Your home EV charger can be connected to WiFi and managed through an app. From your couch! Under a blankie! Holding hot cocoa!

With an app, you can take all of these actions remotely:

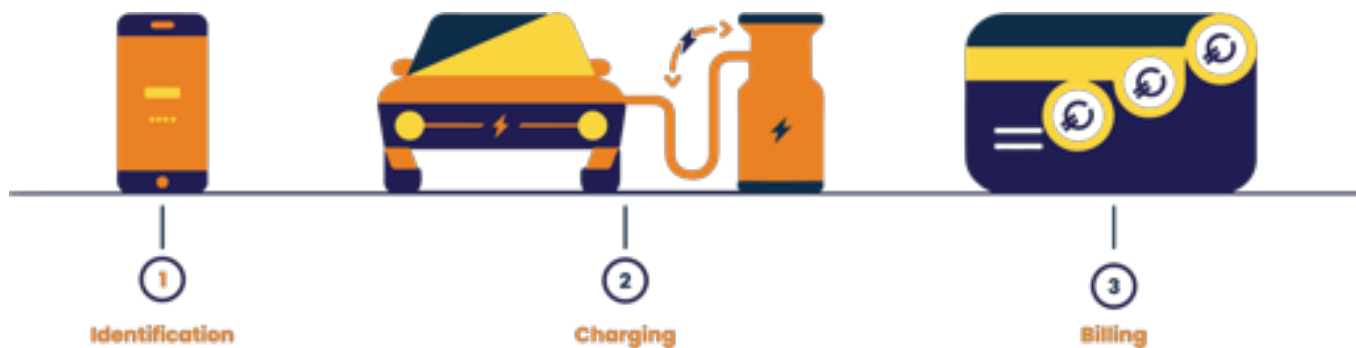
- Charge your EV: Start the charging process from your phone.
- Monitor the charge: Check on your charging status and see how much energy the EV is using.
- Get notifications: Set up alerts for when charging is initiated and completed.
- Schedule charging to save money: If your utility charges you less for electricity during a certain time of day, you can use your app to schedule a charge for your vehicle then.
- Get low battery reminders: Some chargers can be customized to send reminders when the EV is low on battery. Some of the wifi charging models can also be connected to digital assistants like Amazon’s Alexa and Google Home.



## Smart Charging away from home

Public EV charging stations are becoming more prevalent all over the country. Smart charging enables EV owners to track real-time data from them. This means you can see if a charging station is available when you need it.

Use an app like PlugShare or ChargePoint to view station availability and track progress as your vehicle is charging.



# HOW TO USE A SMART EV CHARGING STATION:

1

Log into your mobile app to identify yourself at the charging station and start charging. Doing so connects your EV to the charging point, initiating the process. If you don't have an app, you can make a direct payment with a credit or debit card.

2

Once charging begins, you can monitor the progress remotely on the app, tracking your charging process.

3

Upon full charge or whenever you're ready to leave, you can complete the process and view the applicable billing charges on your app or the charging station. That's it!

A note for Tesla owners: If you're using one of Tesla's Supercharger stations, the identification and billing process happens automatically once you plug in. Remember, Tesla uses proprietary systems so the process is a little different than other EVs'. Otherwise, follow the steps listed above.

Source: <https://www.virta.global/what-it-takes-running-ev-charging-operation-webinar>



# THE ECONOMICS OF EV CHARGING

## Costs:

### The cost of an EV charger is affected by:

- Quality
- Size
- Capacity
- Cord length
- Product warranty
- How you purchase: It's often less expensive to buy your EV charger from the installer directly, rather than buying it on your own and having the installer put it in for you.

### The installation cost depends on:

- Whether it's installed indoors or outdoors. It can be more expensive to install outdoors if you require a pedestal to be anchored in the ground and underground wiring to be run.
- How much electrical conduit will need to be run from the electrical panel to the outlet that the charger is plugged into and if any type of trenching or drywall work is needed in order to access the electric service
- Any needed upgrades to the electric service in order to accommodate charging

**On average, the cost of a level 2 EV charger is \$500–\$750.**

**The average installation cost is \$500–\$2,000.**



## Money savings (vs gas):

With simpler powertrains and a less frequent need for maintenance (e.g. oil changes), EVs typically cost 50% less to maintain and fuel over their lifetime than gas-powered cars.

And, even without the savings on maintenance, EVs come out on top. Powering your vehicle with electricity instead of gas should save you money, whether you make that electricity at home with solar panels or pay for it from the utility company.

This example based on average numbers shows that driving an EV can save \$600 - \$900 a year:

### 2020 Standard Range Tesla Model 3

24 kilowatt hours (kWh) of electricity per 100 miles\*

To drive 100 miles:  
\$3.36 (in electricity)\*\*

To drive 12,000 miles\*\*\*:  
\$403.20

### Typical gas-powered vehicle

Drives 25 miles per gallon at \$2.20 per gallon (average gas price)

To drive 100 miles:  
\$8.80 (in gasoline)

To drive 12,000 miles\*\*\*:  
\$1,056.00

\*Source: <https://www.fueleconomy.gov/>

\*\*National average is 14 cents/kWh

\*\*\*Average annual miles driven



# INCENTIVES FOR EVS AND EV CHARGERS

By buying an EV and installing an EV charger at home, you may be eligible for incentives, rebates, and tax credits from the federal government and from certain states and utility companies.

Speak with your tax advisor to determine if the incentives are available and applicable to you.

## **State incentives for EVs**

EV related incentives vary considerably across individual states. Some are rebates. Some are tax credits. Some vary by the type of electric vehicle. For information on incentives available in your state, go to: State Policies Promoting Hybrid and Electric Vehicles.



## Federal incentives for EVs

At the federal level, there are tax incentives of up to \$7,500. You must meet certain criteria to get the tax incentives:

1. You purchased your EV after December 2009.
2. Your EV uses a traction battery.
3. The vehicle's battery capacity is at least 4 kWh.
4. It recharges using an external plug-in source.
5. It has a weight rating of up to 14,000 lbs.
6. It meets emission standards set by the EPA.
7. The EV manufacturer has not hit the 200,000 vehicle cap. Tesla and General Motors are the only two manufacturers that have hit this cap.

Since these criteria are governed by federal laws, they're subject to change.

Note that the federal tax credit for EVs is non-refundable and dependent on your tax liability. For instance, if you purchase an EV eligible for a \$7,500, but only owe \$4,000 in taxes, you'll get a \$4,000 credit. Also, once a manufacturer reaches 200,000 BEVs and PHEVs sold, credits drop off to 50% of the full amount for six months, then 25% for six months, then zero.

Source: <https://www.irs.gov/credits-deductions/individuals/plug-in-electric-drive-vehicle-credit-section-30d>



## Federal incentives for installing an EV charger

For a long time, the U.S. Federal Tax Credit provided a 30% credit for a home charging station. It expired at the end of 2021 but could be renewed and apply retroactively. Keep your receipts!

The Federal Tax Credit included (and would likely include again) installation costs up to \$1,000.

Source: <https://cleanvehiclerebate.org/en/ev/incentives/state-and-federal>

## State incentives for EV chargers

Home EV charging incentives vary by state. Here are a few examples of incentives offered:

- Maryland: Baltimore Gas & Electric (BGE), Delmarva, Pepco and Potomac Edison are offering a \$300 rebate if a homeowner installs a smart Level 2 charger.
- Connecticut: Groton Utilities is offering a rebate of up to \$600 to customers for an approved Level 2 charging station.
- New York: PSEG Long Island is offering a \$500 rebate for the installation of a ChargePoint Home Flex EV charger. In addition to this, homeowners will receive a \$0.05 per kWh cash back if they charge their EVs between 11 p.m. and 6 a.m.

Find more information on state-level charging incentives at: [State Policies Promoting Hybrid and Electric Vehicles.](#)



# HOW EVS CAN SUPPORT AND STRENGTHEN THE ELECTRIC GRID

EVs can be hugely beneficial for our nation's electric grid. Owners can charge their vehicles at times when renewable energy production is highest, like midday when the sun is hitting solar panels most directly. This lowers stress on the electric grid and reduces the amount of carbon dioxide being emitted by vehicles. Utilities and governments can systematize these programs—and some already do. The common umbrella term is vehicle-to-grid integration (V2G), and it encompasses programs for managed charging, time-of-use rates, and demand response. It's a growing movement across the U.S.

## Types of V2G

V1G (the "1" represents uni-directional charging) is already in use across the country. V1G is the term for managed charging—regulating how many EVs are charging and at what times. This practice is already in use.

V2G is the umbrella term for this whole practice. But, it's also used to describe a specific kind of vehicle-to-grid integration, also called bi-directional charging (hence the "2" in V2G). V2G is a step above V1G. With V2G, energy from EV batteries can be pushed back to the grid to power public building, microgrids, and even your home. V2G is already being used in parts of Asia and Western Europe, and it's rolling out in the U.S. as well.



# READY TO GET AN EV CHARGER?

## WE CAN HELP!

At SUN, we facilitate buying groups called solar co-ops. Free to join, our co-ops are comprised of 50-100 people in the same area, who come together (in person or virtually) to learn about solar and EV charging. Then, using the power of a group, they each get a residential solar system, an EV charger, or both, at a group rate!

See if there's a solar co-op in your area at:

[www.solarunitedneighbors.org/co-ops](http://www.solarunitedneighbors.org/co-ops)



Have questions? Contact us for help at:

[helpdesk@solarunitedneighbors.org](mailto:helpdesk@solarunitedneighbors.org)

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