

Home Charging Guide for New Electric Vehicle Owners



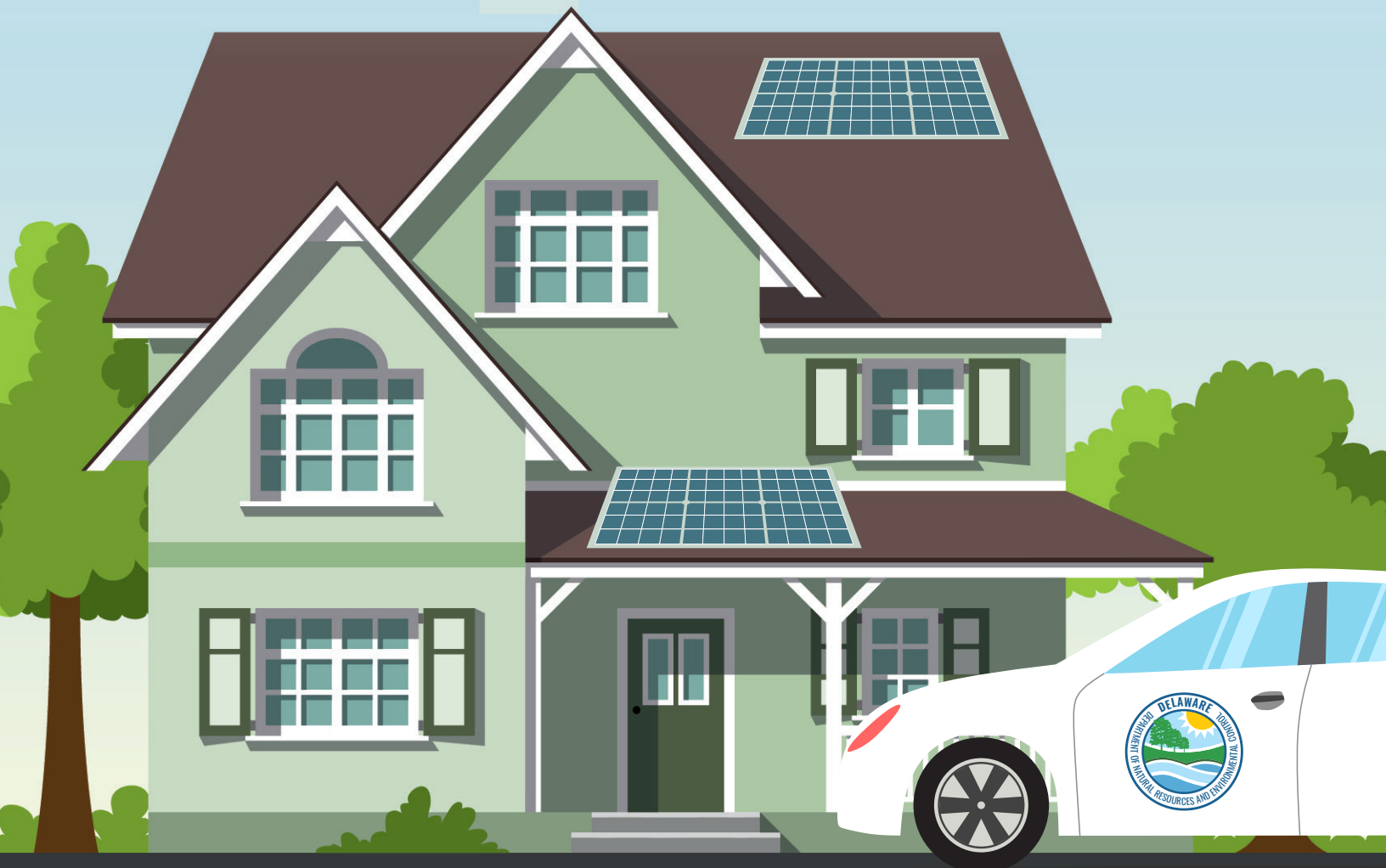
DELAWARE DEPARTMENT OF
NATURAL RESOURCES AND
ENVIRONMENTAL CONTROL

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Introduction to EV Charging



This guide is designed to help you navigate the essentials of home EV charging, making your transition to electric vehicle ownership as smooth as possible. You'll find everything you need, from understanding the basics of EV charging, exploring different types of charging equipment and planning for your home charging setup, to practical advice on installation and managing costs.

We've broken it down into sections, so you can easily reference what you need:

- **EV Charging 101:** Get to know the fundamentals of how charging works.
- **Understanding Electrical Requirements:** Assess your charging needs and home electrical capabilities.
- **Choosing the Right Charging Station:** Select the best equipment for your needs, considering costs, speed and features.
- **Installation Guide:** A step-by-step guide to setting up your home charging station, including necessary electrical upgrades and permitting.
- **Costs and Efficiency:** Learn about electricity rates, time-of-use plans and ways to maximize charging efficiency.
- **Navigating Public Charging:** Tips for finding and using public chargers to optimize your charging experience.



EV Charging 101

Recharging your EV is done through charging stations that connect your vehicle to the electric grid. These stations come in different levels, each providing a different charging speed depending on your vehicle's capabilities. The charging station manages the flow of electricity to your EV, ensuring a safe and efficient charging process.

There are three primary levels of charging available to charge an EV, each offering different speeds and conveniences for EV owners:

Level 1 Charging

Level 1 charging is provided by a standard 120V AC wall outlet. Most electric vehicles come with a Level 1 charger as standard equipment. Level 1 charging is the lowest cost charging station option but has the slowest charging times. A Level 1 charging station provides 2–5 miles of range per hour. Level 1 is a great option for overnight charging of vehicles with smaller batteries, such as plug-in hybrid electric vehicles or vehicles that are used for shorter distances.

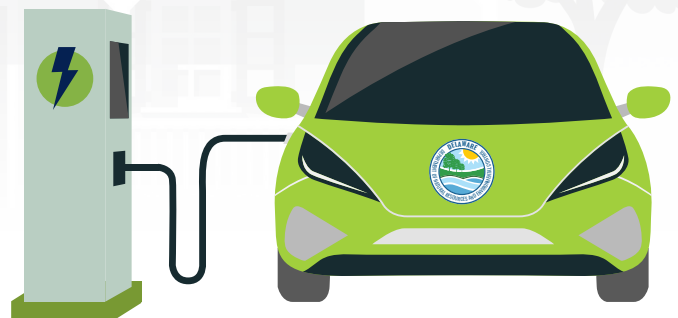
Level 2 Charging

Level 2 chargers use a dedicated 208/240V AC circuit and can provide up to 35 miles of range per hour, depending on the vehicle. These chargers can either be plugged into a compatible 240V outlet or hardwired directly into your home's electrical system. Installation typically requires a licensed electrician and may involve upgrades to circuit breakers or other electrical components. Level 2 charging equipment operates at up to 30 amps, delivering around 7.2 kW of

power, and requires a dedicated 40-amp circuit to meet National Electric Code requirements. Because of these requirements, Level 2 charging solutions are more expensive than Level 1 options but are a popular choice for overnight home charging due to their faster charging speed.

Direct Current (DC) Fast Charging

DC fast chargers typically provide up to 240 miles of range in as little as 20 minutes, though the exact charge and time is dependent on the vehicle and its battery size. With more than 200 public DC fast charging ports across Delaware and more coming, finding charging stations along your travel route at public and retail locations can be quite easy.



Types of Charging Plugs

For Level 1 and Level 2 charging, most EVs use a standardized connector called the J1772. This connector is widely supported at both home and public charging stations, making it easy for most EV drivers to find compatible chargers. Tesla vehicles use the North American Charging Standard (NACS) for all charging levels but come with an adapter that allows them to use J1772 chargers for Level 1 and Level 2 charging.

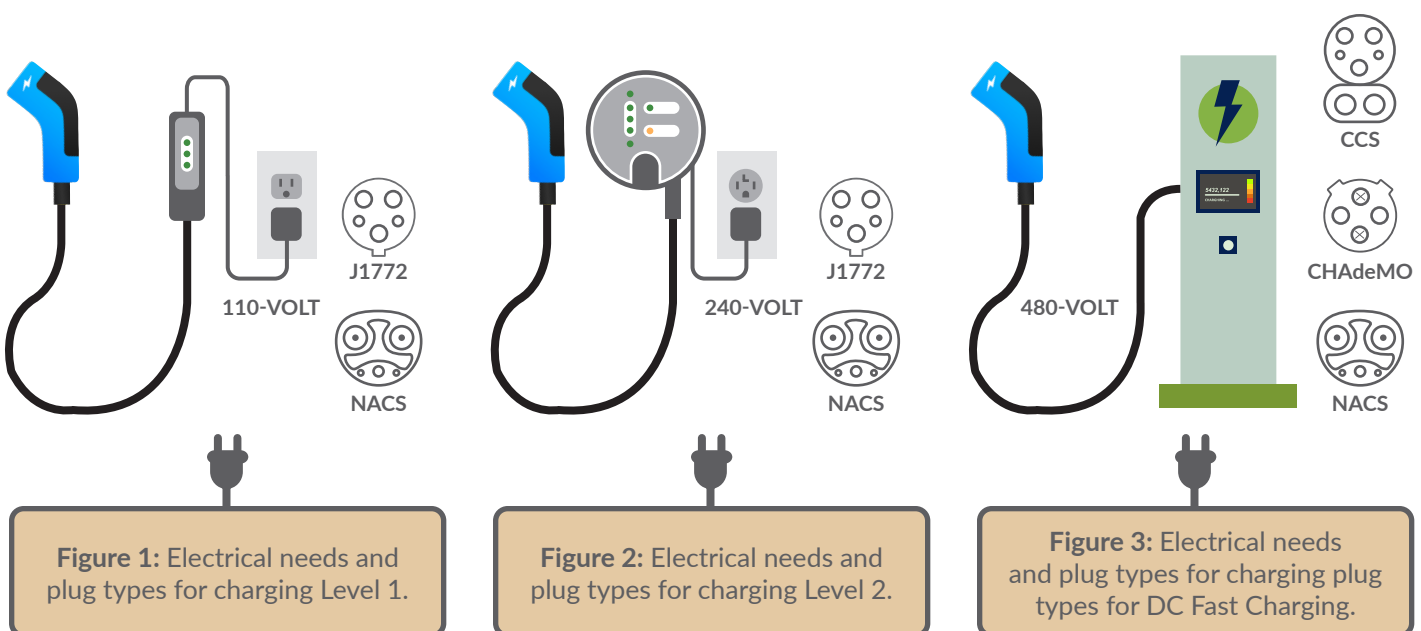
For DC fast charging, there are a few different connector types:

- **Combined Charging System (CCS):** This is the most common fast-charging connector in North America and is used by many EV manufacturers, such as Ford, Volkswagen and GM. It combines the J1772 connector with additional pins for faster charging.
- **CHAdMo:** This fast-charging standard was primarily used by certain automakers like Nissan and Mitsubishi. It's most seen in older models like the Nissan LEAF. While CHAdMo stations are still available, the standard is becoming less common as CCS and, more recently, NACS, gain broader adoption.
- **NACS:** Tesla uses NACS for both home charging and DC fast charging at their Supercharger network. Many other automakers are starting to adopt NACS for their future vehicles, meaning more EVs and charging stations will support this standard in the coming years.

As the industry shifts toward NACS and CCS, drivers will see broader compatibility across public charging stations. However, many stations still offer multiple plug types to accommodate different vehicles, ensuring that most EVs can charge without issue.



Figures 1, 2 and 3 show the different levels of charging, their electrical needs, and the associated plug types.



Understanding How Your Vehicle Charges

To get the most out of your EV charging routine, it helps to understand how your vehicle charges and what factors can affect charging speed and efficiency. Reading your owner's manual can provide details about your specific model, but here are some general things every EV driver should know:



State of Charge (How Full Your Battery Is):

Batteries charge faster when they are nearly empty and slow down as they get closer to full. This is why charging from 20% to 80% is quicker than going from 80% to 100%.



Battery Temperature:

Extreme temperatures — whether too hot or too cold — can slow charging speeds. Charging is most efficient when the battery is at an optimal temperature, which can differ across EV models so it is recommended to check your owners manual to find your optimal temperature range.



Other Power Usage While Charging:

Using features like air conditioning, heating, lights or the radio while charging will draw additional power from the battery, slightly increasing charging time. For example, running your car's climate control while plugged in can divert energy from charging, extending the time it takes to reach a full charge. To maximize efficiency, it's best to limit the use of these features during charging sessions.





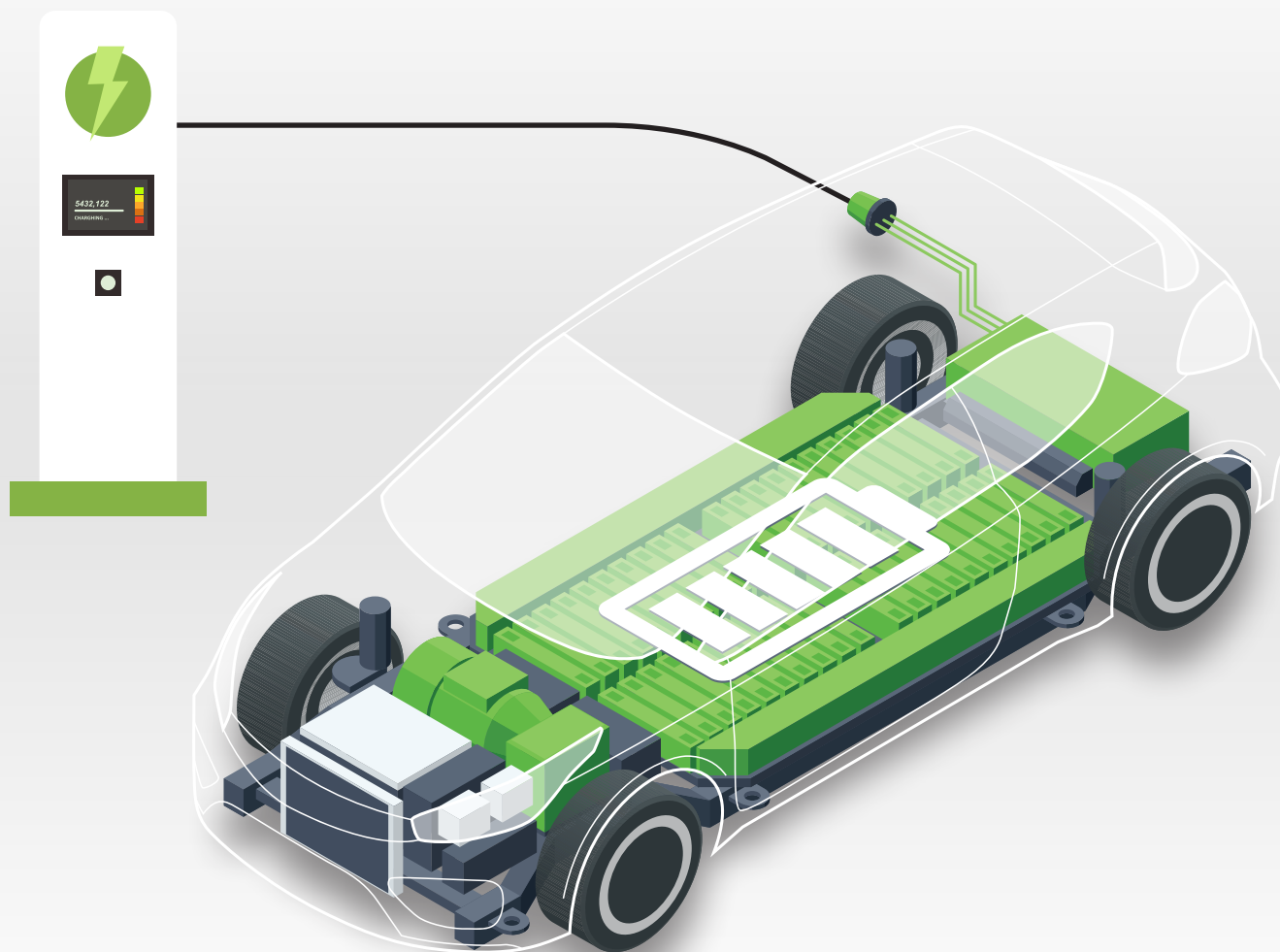
Battery Deterioration Over Time:

Like all rechargeable batteries, EV batteries can lose capacity with age and usage. This natural decline may lead to slower charging and reduced range. However, many EVs come equipped with a Battery Management System that monitors and optimizes charging and discharging processes to help maintain battery health.



Vehicle's Voltage and Current Limits:

When you plug in your EV, the amount of power it receives depends on both the vehicle and the charger. The charger delivers power based on the voltage and amperage limits of both your car and the charger. The charger will adjust to supply only what the car can handle, so if your car has a lower power capacity, it won't take full advantage of a higher-powered charger. Additionally, some energy is lost during charging due to heat and electrical resistance, meaning the total power drawn from the grid might be a bit higher than what's stored in your battery. By understanding these factors, you can better manage your charging habits, improve efficiency and extend your EV's battery life.




Planning for Your Home Charging Solution

Before purchasing and installing home charging stations, it's important to consider your specific needs and circumstances. This planning phase is about aligning your driving habits, vehicle requirements and home electrical capabilities with the right charging solution.


Here are several things to know and consider:

Assessing Your Charging Level Needs

The foundation of a good home charging setup is understanding how home charging will fit into your daily life. Not every EV driver needs to install a Level 2 charging solution.

**Driving Range:**
How far do you typically drive each day?
If your daily commute and errands amount to less than 50 miles, a Level 1 charging solution might suffice. However, if you find yourself driving more, or if you want the peace of mind of faster charging, a Level 2 charger may be a better option for you.



**Future EVs:**
Are you planning to upgrade your EV in the near future?
If so, it's worth considering a charging setup that not only meets your current needs, but can handle future vehicles with higher charging capacities. If you're thinking about adding more EVs to your household or upgrading to a more powerful charger, make sure your electrical system can support additional circuits or a potential panel upgrade. Planning ahead now can save you time and money later.

Do You Need a Level 2 Charger at Home?



Use this chart to determine if a Level 2 charger fits your lifestyle. If your driving habits include longer commutes, frequent trips or multiple EVs, a Level 2 charger will offer more convenience and faster charging times.

DRIVING BEHAVIOR	AVERAGE DAILY MILES DRIVEN	RECOMMENDED CHARGING OPTION
Short Commute, Occasional Errands	Less than 30 miles	Level 1 Charger (standard outlet)
Moderate Commute, Daily Errands	30-50 miles	Level 1 Charger may suffice, but Level 2 adds convenience
Long Commute, Frequent Driving	Over 50 miles	Level 2 Charger recommended for faster charging
Multiple EVs in Household	Varies	Level 2 Charger strongly recommended
Regular Road Trips	Varies	Level 2 Charger plus access to public DC fast charging
Limited Charging Time (e.g., overnight only)	Varies	Level 2 Charger for quicker, efficient charging

Choosing the Right Charging Station

Selecting the right home charging station is another important step when planning for your home charging solution. With the variety of options available, understanding the different models, features and brands can help you make an informed decision that fits your needs, preferences and budget. Look for well-regarded brands known for reliability, strong customer support and comprehensive warranties. Reading customer reviews and checking for certifications can also help ensure you're choosing a quality product.

Here's how to navigate the process:

Equipment Costs

The cost of Level 2 charging stations can vary widely, from a few hundred dollars to more than a thousand, depending on factors like charging speed, brand reputation and additional features. While upfront cost is important, it's also worth considering long-term value, including the durability of the charger. To gauge durability, look for reviews, warranties and certifications that indicate how well the charger is built and how long it's likely to last. A charger with a solid warranty and positive customer feedback can offer peace of mind and savings over time.

Charging Speed

Charging speed is one of the most important factors to consider when selecting a charging station. Most home Level 2 chargers offer a range of output from 2.9 kW to 19.2 kW. However, your vehicle's onboard charger will determine the maximum speed it can accept. For instance, if your vehicle can only handle 7.2 kW, installing a charger with a higher output won't necessarily speed up your charging time. It's important to match the charger's output to your vehicle's capabilities to ensure efficient charging. Higher-capacity chargers are beneficial if you want to future-proof your setup for a new EV or if you have multiple vehicles to charge.

	NISSAN ARIYA	VW ID.4 PRO	CHEVY SILVERADO
Max onboarding charging speed	7.2 kW	11.5 kW	19.2 kW
Battery Capacity	87 kWh	82 kWh	200 kWh
Charger Amperage (kW Output)	Time to charge 20-80%		
Level 1 (1.4 kW)	40.1 hrs 4.2 miles/hr	37 hrs 4.5 miles/hr	90.2 hrs 2.6 miles/hr
Level 2: 30 A (7.2 kW)	7.8 hrs 21.5 miles/hr	7.2 hrs 23 miles/hr	17.5 hrs 13.6 miles/hr
Level 2: 40 A (9.6 kW)	7.8 hrs 21.5 miles/hr	5.4 hrs 30.6 miles/hr	13.1 hrs 18.1 miles/hr
Level 2: 48 A (11.5 kW)	7.8 hrs 21.5 miles/hr	4.5 hrs 36.7 miles/hr	11 hrs 21.7 miles/hr
Level 2: 50 A (12 kW)	7.8 hrs 21.5 miles/hr	4.5 hrs 36.7 miles/hr	10.5 hrs 22.7 miles/hr
Level 2: 80 A (19.2 kW)	7.8 hrs 21.5 miles/hr	4.5 hrs 36.7 miles/hr	6.5 hrs 36.3 miles/hr

Source: Flo Charging



Features to Consider

Modern charging stations come with a variety of features that can enhance your charging experience:

Smart Charging:

Many charging stations offer WiFi connectivity, allowing you to control and monitor your charging sessions from your smartphone. With smart charging, you can schedule charging times, track energy usage and receive updates directly on your phone, making it easier to manage your EV charging efficiently. However, WiFi-enabled chargers tend to be more expensive. If you don't plan to control your charging remotely or prefer a simpler setup, you can opt for a basic model without WiFi to save on costs.



Safety and Reliability:

Look for chargers that are safety certified (e.g., UL listed) and have a solid warranty to ensure reliability and protection against potential defects. Additionally, consider chargers that are ENERGY STAR® certified. ENERGY STAR-certified chargers meet strict efficiency guidelines set by the U.S. Environmental Protection Agency and the Department of Energy, meaning they use less energy during standby mode and help reduce overall electricity consumption. This not only contributes to lower energy bills, but also supports a more sustainable charging solution for your EV.



Weatherproofing:

If you plan to install your charger outdoors, choosing a model that is weather-resistant and specifically designed for outdoor use is crucial for durability and long-term performance. Outdoor-rated chargers are built to withstand rain, snow and temperature extremes, ensuring reliable operation in all weather conditions. Some local electrical codes may recommend or require that outdoor chargers be hardwired to prevent accidental disconnections and provide added protection from the elements. However, many models can also be plugged into a 240V outlet if they are installed with proper weatherproof enclosures. To ensure your outdoor charging setup is safe and compliant with local codes, it's always best to consult with a licensed electrician.



Cable Length:

Consider the layout of your parking area and where you'll install the charger. A longer cable offers more flexibility in where you can park your car relative to the charger, but it may add to the overall cost of the unit. If you have multiple vehicles or a larger garage, a longer cable might be worth the investment for convenience. However, proper cord management is essential for safety and ease of use. Make sure to use hooks or reels to keep the charging cable off the ground when not in use to prevent tripping hazards and potential damage to the cord. Avoid running the cable through areas where it could be pinched, bent sharply or exposed to water, as this could lead to wear and tear over time. Prioritizing good cord management will extend the life of your charger and help maintain a safe charging environment.



Electrical Requirements and Installation Process

For the installation of your home EV charging station, prioritizing safety, efficiency and compliance with local codes and regulations is essential. Before installing a Level 2 charging station, your home's electrical system needs to be evaluated to ensure it can support the charger safely and efficiently. The steps below outline what to expect for a professional, code compliant and hassle-free installation.

What to expect during installation:

Step 1: Site Check

A licensed electrician will look at your electrical panel and charger location to see if:

- There's room for a new breaker (Level 2 chargers need their own circuit).
- Your panel has enough amperage capacity (typically 30–40 amps).
- An existing 220/240-volt outlet can be safely used.



Step 2: Possible Upgrades

If your panel is full or can't handle the extra load, your electrician may recommend adding a dedicated circuit or upgrading the panel. This keeps your home's electrical system safe and prevents overload.

Step 4: Installation

The charger will be mounted, wired, and connected according to the manufacturer's instructions and safety standards.

Step 3: Permits

Some areas require a permit for EV charger installations. Your electrician will usually handle the paperwork and make sure everything meets local codes.

Step 5: Final Check

After installation, your electrician will test the system to be sure it's working correctly. Some areas may also require an inspection from local officials.



Costs of Charging at Home

Understanding the costs associated with charging your EV at home is essential as these costs can vary based on your local electricity rates, the type of charging station you use and your vehicle's efficiency.

Here's a breakdown of the key components that influence home charging costs:

Electricity Rates and Time-of-Use Plans

As mentioned above, the cost of charging your EV at home is largely determined by your local electricity rates. These rates can vary depending on your location and the time of day you choose to charge your vehicle. Both Delmarva Power and the Delaware Electric Cooperative offer time-of-use plans to their customers that provide lower electricity rates during off-peak hours, usually at night. Taking advantage of these rates by charging your EV during off-peak times can substantially reduce your charging costs.

Calculating Charging Costs

To estimate the cost of charging your EV at home, you need to consider your vehicle's battery capacity and your electricity rate. A simple formula to calculate charging costs is:

COST TO CHARGE = Battery Capacity in kWh X Electricity Rate per kWh

For example, if your EV has a 60kWh battery and your electricity rate is \$0.13 per kWh, the cost to fully charge your EV from 0 miles would be:

60kWh X \$0.13/kWh = \$7.80

Keep in mind that the actual amount of electricity needed to fully charge your battery can vary due to efficiency losses during charging.

Maximizing Charging Efficiency


Utilizing a Level 2 home charging station can also affect your charging costs. Although Level 2 chargers are more efficient than Level 1 chargers, they also consume more power. However, the reduced charging time and the ability to take full advantage of off-peak rates often make Level 2 charging a more cost-effective option in the long run.


Monitoring and managing your charging habits, such as scheduling charging sessions during off-peak hours and avoiding charging during peak demand times, can help keep your charging costs down. Additionally, researching incentives and programs offered by your utility and other organizations can provide further opportunities to reduce your home charging costs.


Navigating Public Charging

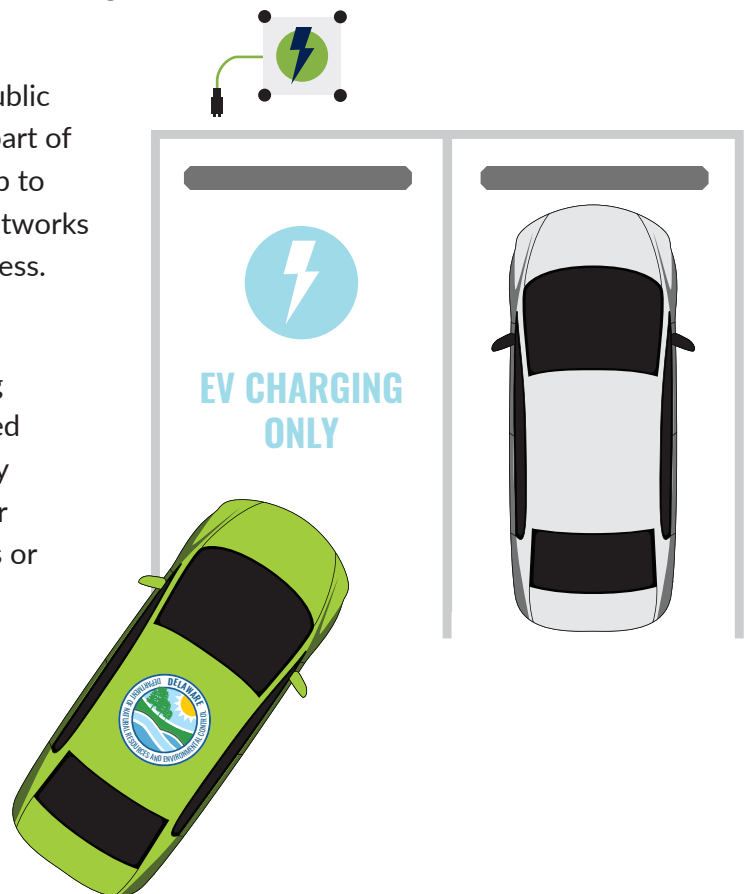
Charging your electric vehicle in public differs from home charging, both in the types of chargers available and how you manage the process. Public stations typically offer Level 2 and DC fast charging options, which allow for quicker charges while on the go. Before heading to a station, it's helpful to know your vehicle's current state of charge to estimate how much charging time you'll need. Most EVs and apps provide real-time updates to help plan your session. As a reminder, it's usually best to charge up to 80% for faster charging times and better battery health, as charging speeds slow significantly after that point. For instance, if you have 100 miles left on your trip but only 50 miles of range remaining, there's no need to fully charge. Just charge enough to reach your destination, then complete a full charge when you arrive. This approach saves time at the charger and helps keep your trips efficient.

Finding and Using Public Chargers

 **Locating Chargers:** To find public charging stations along your route, you can use various apps and your vehicle's navigation system. Apps like PlugShare, ChargePoint and A Better Route Planner are great for showing charger locations, availability and real-time status. Additionally, resources like the Department of Energy's Alternative Fuel Data Center can help you locate stations and plan your journey, including stops at DC fast chargers if needed. These tools make it easier to ensure you have a smooth and efficient charging experience on the go.

 **Charging Network Memberships:** Some public chargers, especially DC fast chargers, are part of networks that require a membership or app to use. It's a good idea to sign up for these networks in advance to streamline the charging process.

 **Charging Etiquette:** Be mindful of charging etiquette. Once your EV reaches the desired state of charge or is fully charged, promptly move your vehicle to allow access for other drivers. Some networks enforce time limits or idle fees to encourage turnover.



Tips for Maximizing Your Charging Experience

Optimizing your EV charging habits, whether at home or at public charging stations, can lead to significant cost savings and help preserve your vehicle's battery health.

Here are practical strategies for both home and public charging:



Utilize Time-of-Use Rates: Take advantage of lower rates during off-peak hours offered through your utility or public charging networks. These lower rates are typically at night or early morning. Scheduling your charging sessions during these times can substantially reduce your electricity costs.



Adjust Charging Speed: Some smart chargers allow you to adjust the charging speed. Opting for a slower charge during peak hours or when you're not in a rush can lead to improved energy efficiency and cost savings.



Monitor and Manage Your Charging: Use smart charging apps or features associated with your charging station to monitor energy usage, track costs and control your charging sessions. This can help you identify the most cost-effective charging patterns and adjust your habits accordingly.



Strategic Use of Fast Charging: While DC fast charging is convenient for a quick charge, it is typically more expensive than Level 2 charging. Frequent use of DC fast chargers can also affect battery longevity. It's best to reserve fast charging for long trips, emergencies, or when you're short on time, and rely on Level 2 charging for daily use to preserve your battery's health.

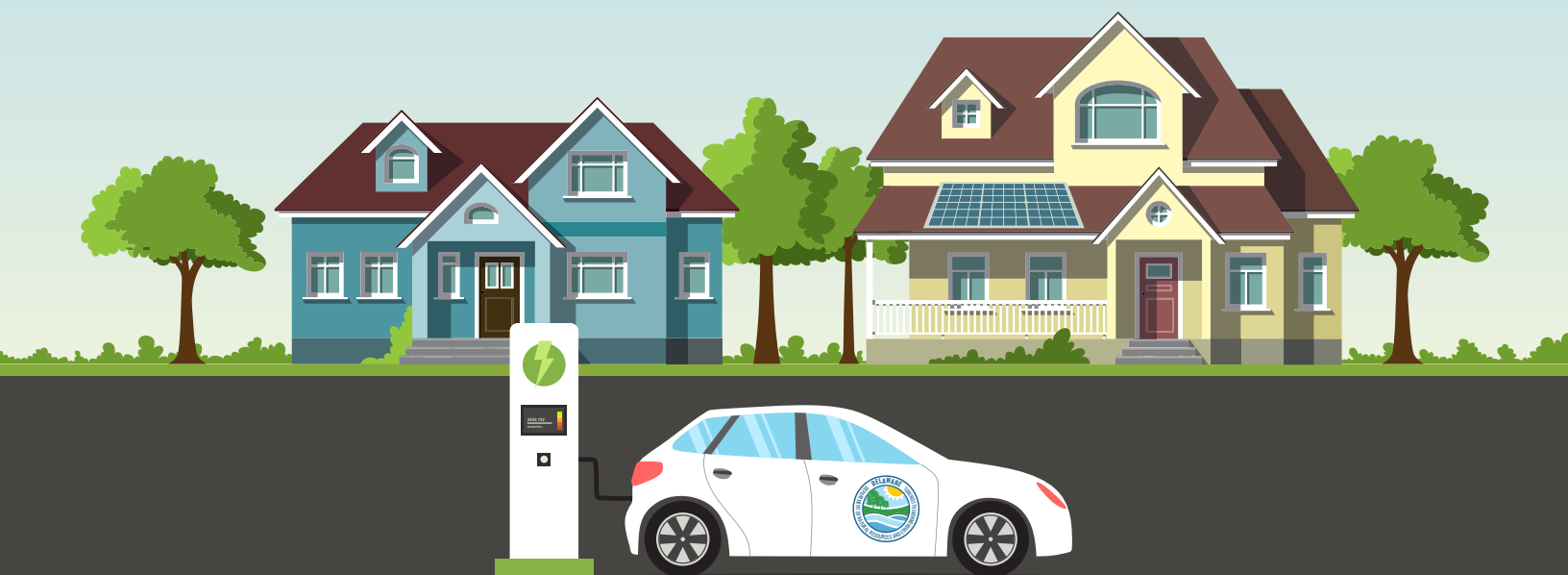


By integrating these strategies into your charging routine, you can maximize efficiency, minimize costs and maintain the longevity of your EV's battery.

Conclusion

Congratulations on choosing a cleaner, more sustainable future with your decision to drive an EV. EVs offer a quieter, smoother ride, lower operating costs and fewer maintenance needs, making them a joy to own beyond their environmental benefits. By transitioning to EV ownership, you're not only enjoying the benefits of advanced technology, but also joining a crucial movement toward environmental sustainability. This shift can provide not only a smoother and more efficient driving experience, but also contributes to reducing emissions, improving air quality and combatting climate change. The convenience and cost savings of charging your EV at home are matched by the positive impact your choice has on reducing reliance on fossil fuels and fostering a healthier Delaware.





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