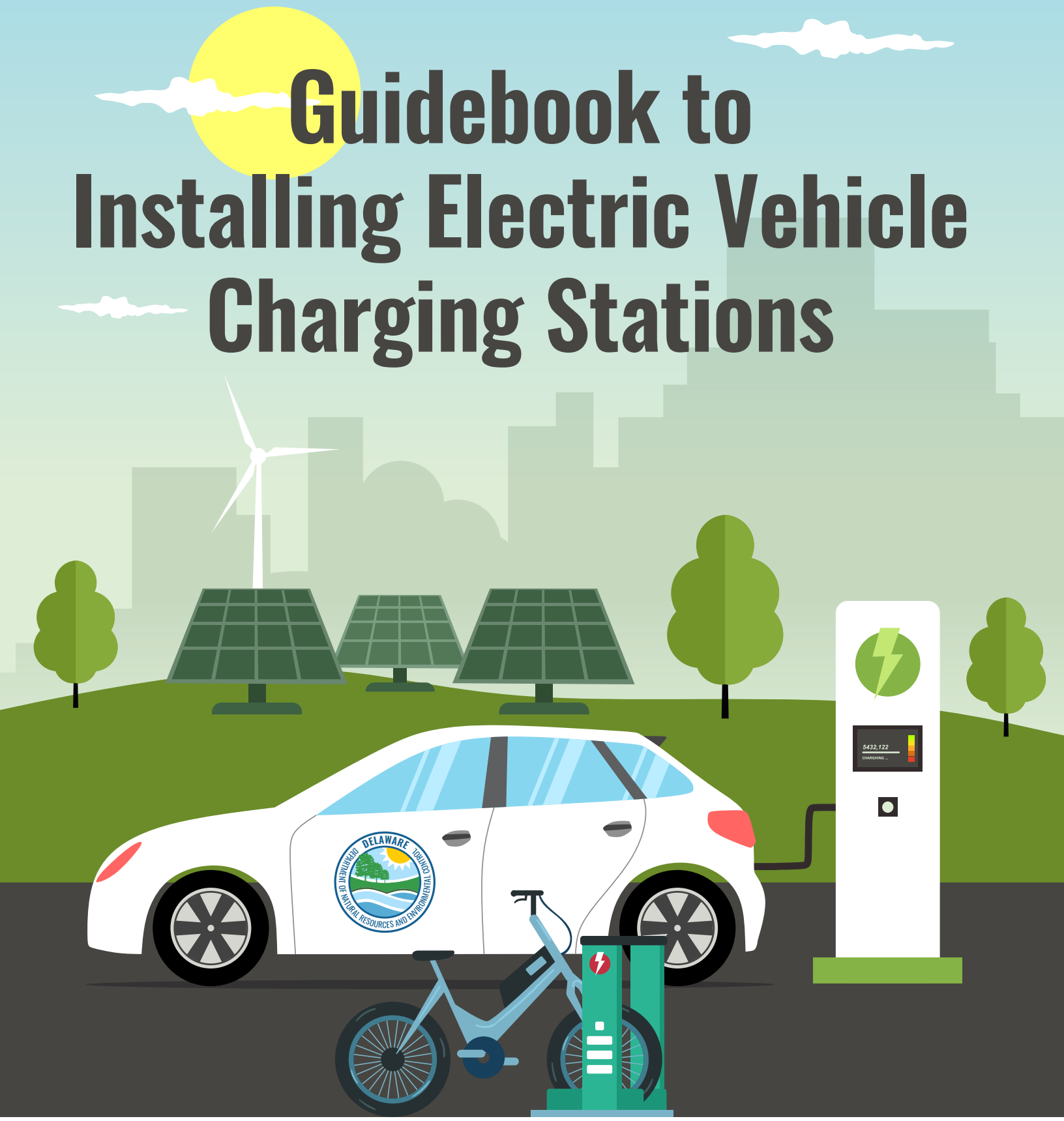
Guidebook to Installing Electric Vehicle Charging Stations



DELAWARE DEPARTMENT OF
NATURAL RESOURCES AND
ENVIRONMENTAL CONTROL

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Introduction

Greenhouse gas emissions from the transportation sector are the largest source of greenhouse gases in Delaware, particularly from light-duty passenger vehicles. Exhaust from these vehicles has been linked to significant health problems, including asthma, chronic bronchitis and heart attacks.

The dominance of automobile travel continues to exacerbate pollution, congestion and health issues, along with income and racial disparities, which disproportionally affect communities of color and lower income populations. The transition to electric vehicles (EV) provides an opportunity for communities to improve air quality and prepare for climate change while also providing economic opportunities for residents and businesses. Electric vehicle sales are growing rapidly in the United States and in Delaware, leading to a greater demand for electric vehicle charging opportunities across the state. Facilitating and incentivizing the transition to zero-emission electric vehicles is a key strategy for reducing these emissions and improving air quality. Delaware's Climate Action Plan[1] also recognizes and emphasizes the need for this transition.

[1] https://documents.dnrec.delaware.gov/Air/Documents/2018-DE-GHG-Inventory-Fact-Sheet.pdf

Benefits of Offering Charging Stations

As we charge in the future, Delaware is working to make sure that more electric vehicles are available for residents and businesses.[2] The large increase in EV sales and ownership will require property owners to consider installing stations for customers, employees and residents.

Delaware does not currently have enough DC fast or level 2 charging station ports (see EVSE section) to support the number of electric vehicles registered in the state. To support the anticipated number of registered EVs by 2030, hundreds more DC fast and Level 2 charging stations will need to be installed throughout Delaware.

Charging stations have multiple benefits that make the investment worthwhile. Installing charging stations can provide businesses and property owners a revenue source, can attract new customers, and can increase and retain tenants and employees. Organizations that participate in green programs such as LEED certification or value green initiatives can also count installing EV charging stations towards program goals.

[2] https://dnrec.alpha.delaware.gov/climate-plan/

About This Guidebook

This guidebook will introduce you to electric vehicles and assist you in assessing options for choosing and installing electric vehicle charging stations. It provides an overview of the types of chargers available, considerations for selecting the best charging station for your use and considerations for siting and maintaining charging stations. It is also meant to provide you with enough information so you can ask the right questions and make informed decisions about the best charging stations for your needs, whether you wish to install charging stations to charge your new fleet electric vehicles, for residents of your apartment complexes, for your employees or for visitors to your town. This guidebook frequently uses acronyms and phrases unique to EVs. If these are unfamiliar to you, please refer to the glossary and list of acronyms found at the end of this guidebook.

Electric Vehicle Technology

Electric vehicles use electricity as either a primary or secondary fuel source. They can be classified into two categories: battery electric vehicles and plug-in hybrid electric vehicles.

Battery Electric Vehicles (BEV)

Battery electric vehicles run exclusively on electricity and are charged from an external electrical source. Battery electric vehicles can travel between 100 and 300 miles or more on a single charge, depending on the make and model of vehicle and how the vehicle is driven. These vehicles use regenerative braking, which uses the vehicle's motor as a generator to convert the energy lost when braking back into stored energy in the vehicle's battery. Examples of battery electric vehicles include the Nissan Leaf, Ford Mach-E, Volvo XC40 and any Tesla model. There are now over 40 battery electric vehicle models in the U.S. to choose from, with more choices each year.

Plug-in Hybrid Electric Vehicles (PHEV)

Plug-in hybrid electric vehicles have a battery that is charged from an external source, paired with an internal combustion engine. The externally charged battery allows the plug-in hybrid electric vehicle to operate fully on electric power for short distances before the internal combustion engine turns on. The all-electric range of plug-in hybrid electric vehicles varies from 10 miles to over 40 miles, depending on the battery size. By charging the battery daily, or between trips, many plug-in hybrid vehicles can operate exclusively on battery power for most household or commercial uses. Plug-in hybrid vehicles also use regenerative braking, which can extend the battery range even further. There are over 30 models of PHEVs available in the U.S., including the Toyota RAV4 Prime, Chrysler Pacifica and Kia Niro.

Conventional Hybrid Electric Vehicles (HEV)

It can be easy to confuse plug-in hybrid electric or battery electric vehicles with conventional hybrid vehicles. Conventional hybrid vehicles have a small battery that is charged using a combination of energy from regenerative braking and power from the internal combustion engine. Some of these vehicles have electric motors that turn the engine off when the vehicle is idling, braking or moving at slow speeds, which helps increase fuel efficiency. Conventional hybrid vehicle batteries cannot be charged from an external source and cannot utilize charging stations. Because they cannot be plugged into an external power source, conventional hybrids will not be discussed further in this document.

Electric Vehicle Supply Equipment (EVSE)

Recharging EVs is accomplished through connections to electric vehicle supply equipment (EVSE), commonly referred to as charging stations. The EVSE is the conduit, control and monitoring device that connects the vehicle to the electric grid. There is a range of charging station levels based on the rate at which the vehicle can charge. Higher levels indicate a faster charging rate but typically cost more and may require electrical upgrades to the site's infrastructure.

Level 1 Charging

Level 1 charging is provided by a standard 110V 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. Level 1 charging is not adequate for vehicles with longer battery ranges. A fully depleted battery on an electric vehicle with a 200-mile range battery could take several days to fully charge with a Level 1 charger.

Level 2 Charging

Level 2 chargers use a 208/240V AC outlet and provide up to 35 miles of range per hour, depending on the vehicle. Installation of these stations typically requires the services of a qualified electrician and may require upgrades to circuit breakers, transformers and other associated electrical equipment. Because of this, Level 2 charging solutions are more expensive than Level 1 charging solutions.

Level 2 chargers are typically selected for any site where a vehicle can sit for several hours to charge. These sites include homes, shopping centers, employment centers, recreational areas, tourist destinations and businesses. Level 2 chargers can be installed as a service to customers or employees and can be a way to attract new customers to a business or downtown area. They are also typically chosen for business and government fleet charging.

Level 3 or Direct Current Fast Charging (DCFC)

Sometimes referred to as Level 3, DC fast charging can fully charge a battery electric vehicle in under an hour, depending on the vehicle's range and battery size. Because of the energy needed to supply these stations, DC fast charging stations, as well as site preparations and electricity upgrades, are much more costly than for Level 1 or Level 2 charging. DC fast charging stations are generally installed where drivers need a full charge in a short amount of time, like along highway corridors and at rest stops. DC fast charging stations are analogous to gas stations, where a driver stops for a short period of time and then continues their trip. DC chargers are bigger, faster, and help alleviate the range anxiety that some drivers experience on long trips.
Note: Not all electric vehicles can fast charge. Almost all plug-in hybrids and older EV models cannot.

Types of Charging Plugs

Recharging at a public charging station requires drivers to first determine the compatibility of their EV with the charging station's available plugs. The most common plug is the SAE J1772, which is the standard connection for Level 1 and Level 2 charging and is supported by all major vehicle manufacturers and charging station manufacturers. This standardized connector makes virtually every EV compatible with every Level 1 or Level 2 charging station.

DC fast charging stations do not yet have a standardized plug and receptacle configuration. Most of the DC fast charger–capable EVs are compatible with at least one of three commonly available connectors. The two most used connectors for DC fast chargers are CHAdeMO and SAE Combined Charging System (CCS). CHAdeMO is the standard connector for Japanese auto manufacturers, and CCS is the standard connector for American and European automakers.

The CHAdeMO connector is currently being phased out in the U.S. While new vehicle models in the U.S. will use CCS exclusively, providing charging stations that can accommodate CHAdeMO is necessary to support older EV models.

The third connector is proprietary, is specific for Tesla models and has a network of charging stations around the globe. The Tesla Level 2 and DC fast charging stations can be used only by Tesla vehicles and are not compatible with vehicles from any other manufacturer. However, Tesla vehicles can charge their vehicles using non-Tesla charging stations by using adapters. Because Tesla vehicles can charge at most charging stations, there is limited benefit to installing a Tesla-specific charging station for most charging station projects where the intent is to provide charging to the public or employees.

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

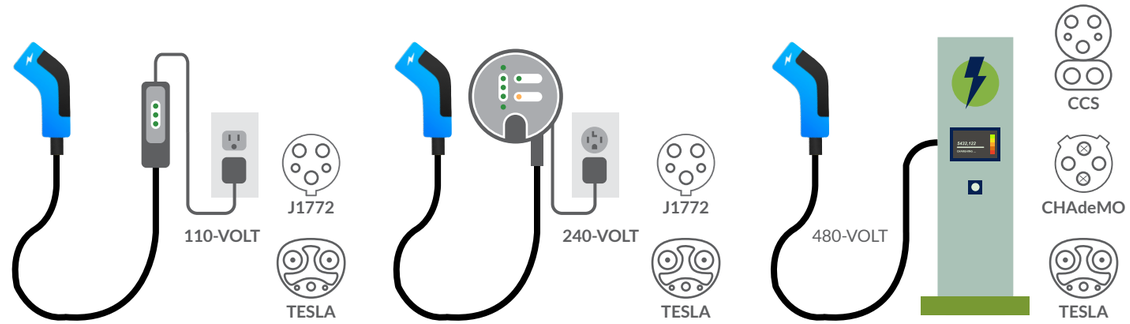


Figure 1: Electrical needs and plug types for charging Level 1.

Figure 2: Electrical needs and plug types for charging Level 2.

Figure 3: Electrical needs and plug types for charging plug types for DC Fast Charging.

Charging Station Planning and Design

The key to successful charger installation and operation is proper planning. While plugging an EV into a charger is simple, the planning and design of electric vehicle charging stations, as well as various connectivity options, can become complex and confusing. Understanding your potential charging needs is important when choosing a station.

Determination of Equipment Needs

The first step in planning a charging station installation is to think about who is most likely to charge their EV at your facility. Charging station users may be a small number of targeted people, such as building tenants or employees, or could be much more general, such as customers of a shopping area. Level 2 EVSE can range in complexity from basic units, like those installed in residences with a power draw similar to an electric dryer, to those that are fully networked and offer either restricted access or open access with options to accept payments, monitor usage and provide comprehensive data to the station owner.

Basic EVSE

Basic EVSE models, also known as non-networked chargers, only communicate with the vehicle during a charging session. Basic stations cannot supply any data to the driver or station owner and cannot charge a fee to customers for charging. These models are usually found in individual homes or in locations that want to provide charging for free. Basic charging stations typically cost less than $1,000, not including installation.

RFID EVSE

EVSE with integrated radio frequency identification (RFID) readers allow a charging station owner to limit access to charging without a network or costly networking fees. RFID readers are key cards that are programmed to each station. With the correct software and management, one key card can be programmed to access multiple stations. Employers, residential property owners and hotels can benefit from RFID readers to limit access to charging to employees, residents or guests.

Smart EVSE

Smart EVSE are networked and communicate with the vehicle and cellular networks to provide advanced features and enhanced options for charger operators. These features and options can include ability to accept payments, ability to set charging time or electricity limits and ability to download comprehensive data about charger use. The capabilities offered by a smart charger typically make the up-front cost more expensive. Depending on the type used, smart chargers also typically

require an on-going monthly, per session or annual networking fee to the user, site host or both. The levels of communication available for a smart charger can include communication with the site host, utility grid, internet and user. Smart EVSE usually connects by cellular, Ethernet or Wi-Fi. In considering whether smart EVSE is right for you, it is useful to note that multi-level parking structures can have network connection complications and repeaters may need to be installed to ensure communication capabilities. Smart EVSE Level 2 stations typically have an up-front purchase cost of $2,500 or more, not including installation. As noted above, there are often on-going monthly or annual fees for the user, the site host or both.

Table 1 details a variety of additional features and benefits of using Smart EVSE.

FEATURES	BENEFIT
Point of sale (POS)	Allows units to recover costs/fees associated with charging events. Options could include a credit card reader, RFID reader or mobile phone application.
Energy monitoring	Provides reports on energy consumption and greenhouse gas emissions reductions. This can help site hosts show how the EVSE is contributing to their sustainability goals.
Energy management	Optimizes energy load management to maximize charging during periods when electricity costs are lowest and minimize charging during periods when electricity costs are high. For instance, an EVSE can be programmed to charge a vehicle only during predetermined times to avoid electricity demand charges.
On-demand charging management	Enables an EVSE operator to remotely update pricing, change message screens, and control other charging parameters via web application.
Advanced display screens	Provides user communication, advertising and brand promotion.
Remote troubleshooting and upgrades	Provides ability to remotely upgrade software and troubleshoot issues.

Table 1: Additional features and benefits for charging station owners and users.

Types of Fee Structures

Four basic types of fee structures for electric vehicle charging stations: flat rate, per hour, per kilowatt-hour (kWh) and hybrid[3]. These pricing structures, along with additional considerations, are described in the following pricing structures.

As you review the following types of pricing structures, it should be noted that, in general, Level 2 charging stations are installed as a service to EV drivers and to attract new business to locations. Charging a reasonable fee for EV charging will generally not be very profitable in and of itself, though there are many other benefits. Charging a relatively high fee for EV charging could disincentivize EV drivers from using your new station(s). A best practice is to set fees to a level that will offset the ongoing electricity and networking cost of the station.

[3] https://atlaspolicy.com/wp-content/uploads/2020/04/Public-EV-Charging-Business-Models-for-Retail-Site-Hosts.pdf

Flat Rate

The simplest option is to charge a flat fee per charging session. This would mean that an EV driver would pay a small fee to initiate a charging session, no matter how long they charged or how much electricity they used. While simple and easy to implement, this option creates inequities because the same price is paid by someone using the charger for 6 hours for 70 kWh of charge as someone charging for an hour and using 10 kWh of charge. It also does not provide a pricing mechanism that would encourage drivers to move their vehicle after charging is complete to allow someone else to charge their vehicle.

Hourly Rate

Networked charging stations can be set to charge a fee by the hour or partial hour. Depending on the station, the fee can end when the charging session is complete or continue until the car is unplugged. Hourly fees, especially those that continue until a car is unplugged, can be used as a strategy to encourage EV drivers to unplug and move when charging is complete, freeing up the space for another EV driver.

Each model of electric vehicle accepts electricity at a different rate; this means that some cars will use more electricity in an hour than others. This difference can be substantial. If the hourly cost is too high, a driver of a car with a relatively slow charging rate may not use the station because the cost per kWh would be relatively high.

Per Kilowatt-Hour (kWh)

Another simple payment collection option for site hosts is charging customers by kWh for electricity. According to the U.S. Energy Information Administration, the average retail cost of electricity in Delaware is $0.11 per kWh, along with additional fees by the electricity provider.[4] Charging by kWh, however, does not allow hosts to deter customers from staying in spaces after charging is complete but does consider charging speed and allows the host to recover costs quickly. This is the most equitable way operators can charge for electricity because the cost to the EV driver is directly tied to the amount of energy they are receiving.

Hybrid per kWh/Hourly

A hybrid method in which customers are charged both per kWh and an hourly rate resolves some issues with drivers not moving their vehicles and addresses concerns about slower charging vehicles. Many networked charging stations will allow you to set a range of fee options and combinations. It is a good question to ask as you investigate station capabilities. The hourly rate can kick in after a set amount of time, which helps address vehicle rotation.

Questions to consider when selecting a charging station:

1. Do I want to charge a fee for electric vehicle charging or provide it free as an amenity?
2. Would I like to collect data on station and electricity use?
3. Do I want to use a fee structure to encourage EV drivers to move their vehicles once they are charged or reach their time limit?
4. Do I plan to limit access to specific users, or is the charger available for anyone?
5. Do I have a budget for network fees and maintenance?

[4] https://www.eia.gov/electricity/state/delaware/

EV Charging Location Selection

Existing site conditions will influence the type of EVSE that can be installed and where it can be installed. The most common factors are proximity to the power connection and amperage for that connection. Other key factors to consider in siting EV charging equipment are mounting approach, parking space dimensions, locations and capacity and network connection capability. In addition, county and local governments are increasingly incorporating requirements for EV charging into their building or energy conservation codes. Be sure to check for permitting requirements or ordinances with your local county government or municipality prior to installation.

Site Assessment

Potential EVSE hosts are encouraged to have an electric contractor complete a site assessment as an initial step in planning and budgeting for an EVSE installation. An initial site evaluation should include determining the electrical capacity of the site, the location of the distribution or service lines, the required electrical capacity for the type and quantity of planned EVSE units and the best location for the EVSE unit(s). The best location for the units will take into consideration minimizing the installation costs and ADA accessibility requirements.

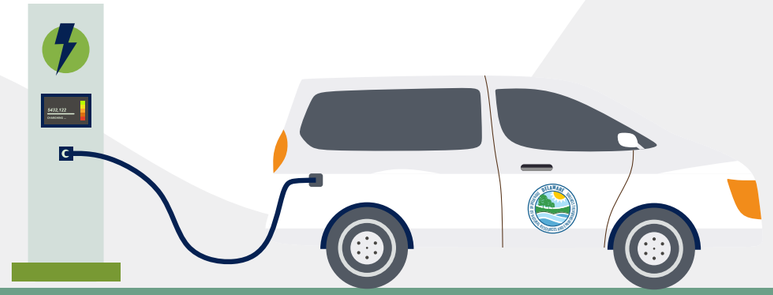
Power Availability (240V for Level 2, 3-phase for DC Fast Charging)

There are three fundamental needs when it comes to powering EVSE:

- a dedicated circuit for each EVSE unit on the electrical panel
- ample electrical capacity from the utility connection to the electrical panel
- sufficient electrical capacity from the electrical panel itself.

Complexity of charging station installation and a need for electrical upgrades in any of these areas may increase installation costs.

One of the major cost variables of an EVSE installation is the immediate proximity of adequate power. In general, the closer the charging station site is to the power source, the less expensive the installation will be.



Parking Space Considerations

The majority of workplace and public EV charging will be in parking lots with perpendicular parking. Figure 2 below is an example of a wall-mounted installation, which is typically the most cost-effective method of installing charging equipment if the parking area is designed this way. Installation costs are reduced by eliminating pedestal mounts and by allowing shorter conduit runs along building walls.[5]

The parking configuration in Figure 3 illustrates typical parking stall dimensions of 9 feet wide by 18 feet long. A 5-foot-wide aisle between Americans with Disabilities Act (ADA) accessible spaces provides room for users with disabilities to maneuver. As shown by the cord reach area, this configuration can serve several parking spaces by allowing drivers to park in the appropriate spaces or back in as necessary to provide access to the vehicle charging port. Charging port locations for several vehicle models are show in the diagrams below.

Figure 3 below shows an example layout of EV charging that is centrally located between parking aisles with the same typical parking stall dimensions of 9 feet wide by 18 feet long. This configuration can serve several parking spaces depending on the length of the charging cord.

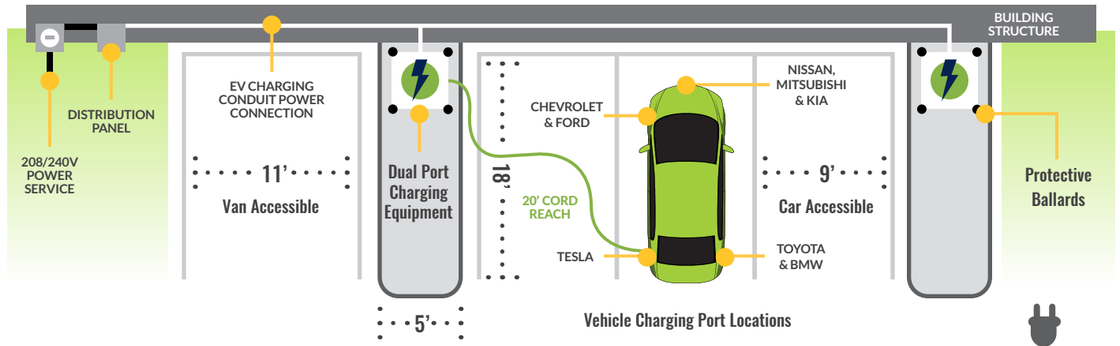


Figure 2: Wall-mounted EVSE example site plan.

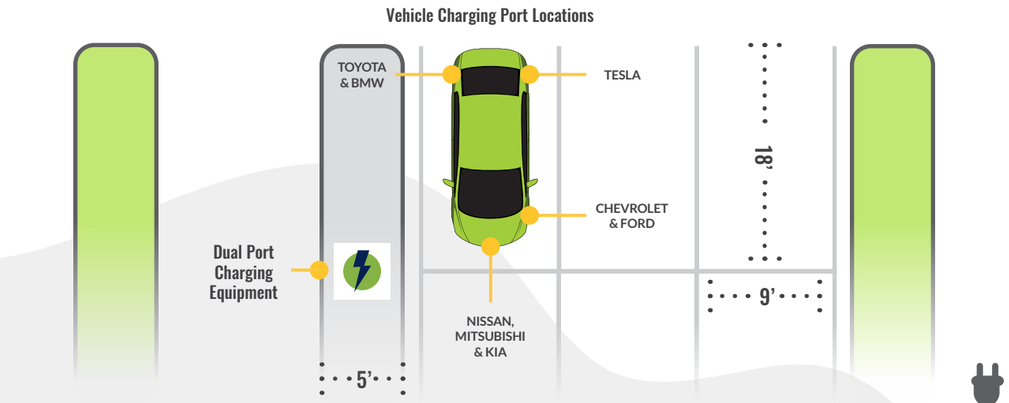


Figure 3: Perpendicular parking lot site plan example.

[5] https://www.driveelectricvt.com/Media/Default/docs/electric-vehicle-charging-station-guidebook.pdf

ADA Compliance

The Americans with Disabilities Act (ADA) requires public parking areas to be accessible to users in wheelchairs or with other mobility limitations. The U.S. Access Board establishes accessibility standards for public facilities, such as parking areas and fueling stations and has released a technical guidance document [6] to assist in the design and construction of EV charging stations that are accessible to and usable by people with disabilities.

The most common approach for construction of new EV charging locations is to adapt an existing parking space for use by EV owners. If there are issues with providing a fully accessible location, then components of ADA requirements should be met to the extent possible. At this time, it should not be necessary to restrict use of accessible EV charging to disabled users only, but the general recommendation is to make the first charging space accessible.

Figure 4 shows the U.S. Access Board's recommended measurements for an accessible EV charging station parking space.

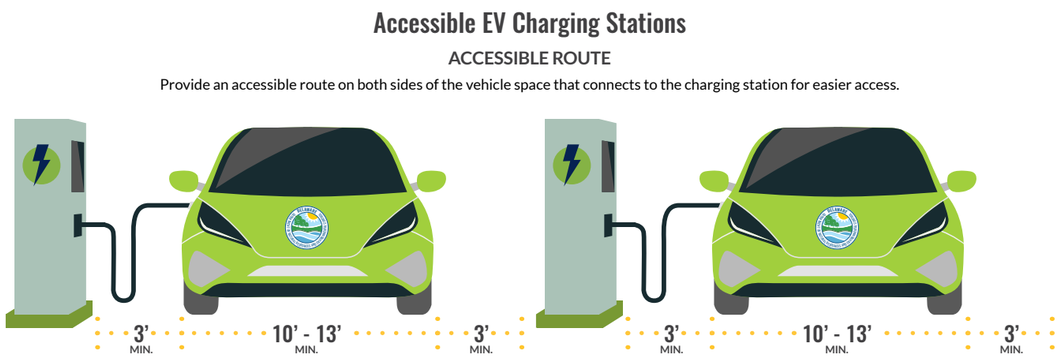


Figure 4: Accessible EV charging station parking space design recommendation.

Mounting Options and Considerations

There are several options available to mount a charging station. An existing wall, pole, column, post or pedestal could be used to mount the charging station. Many EVSE sites use wheel stops to prevent vehicle contact with the charging equipment, but these can be problematic for snow removal. Bollards can also provide protection for EVSE and are recommended over wheel stops to increase accessibility. With very limited exception, at least one EV charging parking spot should be accessible to individuals with disabilities (see ADA Compliance section above).

[6] https://www.access-board.gov/tad/ev/

Lighting and Visibility

Lighting should also be considered for EVSE. Lighting can increase safety and security of a site and deter vandalism. If lighting upgrades are necessary, it may present an opportunity to extend wiring for EVSE installations. Almost all parking facilities are designed with lighting. Locations where charging stations will be installed should be checked for nighttime lighting levels between parked cars, especially if the style of EVSE being used has cables that extend along the ground between the EVSE and the charging port on the vehicle. Dim lighting coupled with cables along the ground could create a tripping hazard or damage cables.

Cord Management

Charging port locations on electric vehicles will vary based on manufacturer, so you will want to have a charging cord long enough to accommodate this. It is recommended to use a cord management system to keep the cord off the ground and minimize tripping hazards and cord damage. Cord management systems also save time for drivers and eliminate the need to wrap the charging cable around the station.

Preparing Your Site for the Future

Sales and popularity of EVs are steadily increasing, and several new electric vehicle models are coming out over the next few years.[7] As more electric vehicles are on our roads, more charging stations will be needed to fuel them. Site owners should consider future EVSE needs in designing their projects, especially if electrical upgrades are necessary. The largest cost of installing EVSE infrastructure can be installation of conduit under paved surfaces and electrical upgrades. If additional charging stations may be necessary in the future, these upgrades can be done now to avoid doing the work more than once.

EV Capable is an installed electrical panel capacity with a dedicated branch circuit and raceway from the panel to a future EV spot, but it lacks a power outlet. It is cheaper to plan for future EVSE installation by also installing EV-ready outlets and EV-capable parking spaces at the time of construction or renovation, or when installing EV charging stations.

EV Ready refers to installed electric panel capacity and a raceway with a conduit that terminates in a junction box. This type of setup is typically for a 240-volt (Level 2) charging outlet.

Figure 5 shows two ways you can prepare your site for future charging stations:

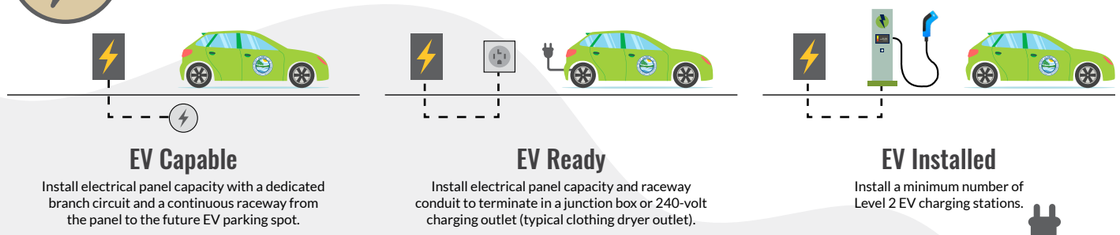


Figure 5: Two ways to prepare the site for future charging stations.

[7] https://www.consumerreports.org/hybrids-evs/hot-new-electric-cars-are-coming-soon-a1000197429/

Questions to consider when selecting a location:

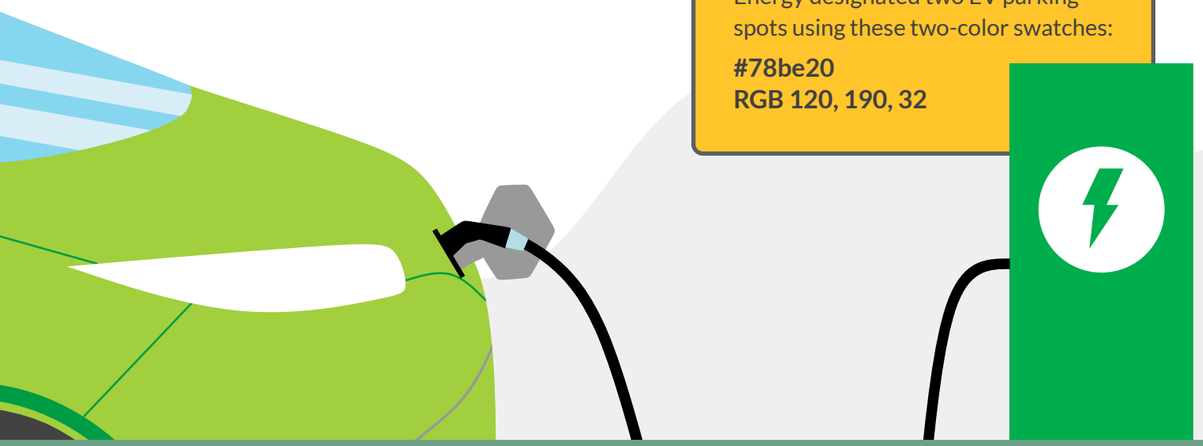
1. *How many stations do I plan to install?*
2. *What part of my property provides the optimal conditions for EV users to find and use the EVSE safely and conveniently? Does this align with the portion of my property nearest to the electrical supply?*
3. *Do I anticipate a need to install additional charging stations in the future?*
4. *Are there regulations or ordinances that require a specific numbers of parking spaces to be EV-ready or EV-capable?*

Signage

Visibility of EVSE and wayfinding signage is especially important. There are three primary types of wayfinding signage used to identify EV parking: general service signs, regulatory signs and parking spot stencils and other signage. General service signage helps EV drivers locate an EV parking space and increases awareness that EV charging is available. Regulatory signage designates a space for a specific use and can involve time restrictions. Parking spot stencils and other signage help to increase visibility and clearly identify spaces. All should be provided for any EVSE installation. It is important to be consistent with EVSE signage to help drivers easily locate EVSE regardless of the brand of the charger.

Marking tip: Use green to indicate electric vehicle charging–only spaces. The Division of Climate, Coastal and Energy designated two EV parking spots using these two-color swatches:

#78be20
RGB 120, 190, 32



General Service Signs

The Federal Highway Administration regulates national traffic control devices, including signage, through the Manual on Uniform Traffic Control Devices[8]. This manual is updated every 5–6 years for states to adopt guidance on national standards for highway and roadway signs and traffic control devices. Delaware last updated the Delaware manual in 2018[9].

Chapter 2 of the Manual on Uniform Traffic Control Devices contains standards, guidance and options for all sign types on highways, private and public travel roads. In the Delaware manual, acceptable signs that alert travelers to EV charging stations include sign D9-11b and D9011bP (Figure 6). Additionally, these signs can be combined with arrows and mileage for wayfinding purposes.

Station/Regulatory Signage

Station signage, including signs that regulate parking and time limits are not standardized under the national guidelines; therefore, no official guidance on regulatory signs has been issued. However, in June 2013 the Federal Highway Administration issued temporary recommendations for regulatory signs related to EV charging stations, as shown in Figure 7.[10]

EV charging stations are typically located in areas closest to power, but these locations are often far away from traditional fueling stations and can be easy to miss. Signs for EV charging stations can be easily mistaken or confused with handicap parking because they are blue. Therefore, a best practice for site hosts is to use regulatory signs in addition to general service signs to draw attention to EV charging stations.

[8] https://mutcd.fhwa.dot.gov/
[9] https://deldot.gov/Publications/manuals/de_mutcd/index.shtml
[10] https://mutcd.fhwa.dot.gov/resources/policy/rsevcpfmemo/

Parking Space Stencils and Other Signage

Additional EV charging station signage includes trailblazing signs and parking space stencils. Trailblazing signs are special signs that can be used at host locations to provide additional information to the driver, including funding source, company name and tourism information. Parking space stencils, much like for handicap spaces, indicate EV parking spaces. Neither parking space stencils nor trailblazing signs are regulated; therefore, specific signage that will be located on the property is at the discretion of the jurisdiction or property owner.

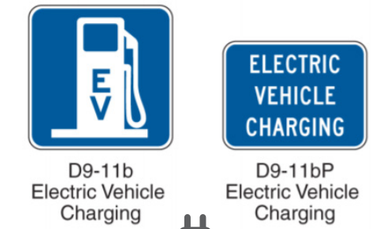


Figure 6: Examples of general service signs for EV charging stations from the Delaware Manual on Uniform Traffic Control Devices.

Figure 7: Examples of station/regulatory signs for EV charging stations from the Delaware Manual on Uniform Traffic Control Devices.

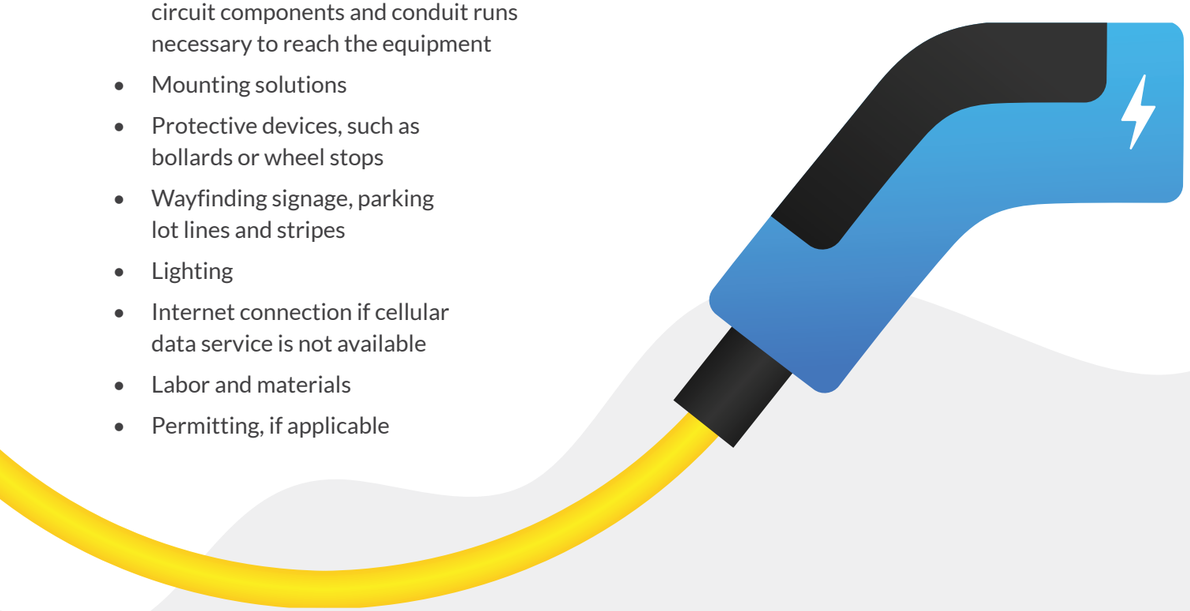
Charging Station Installation and Operating Costs

Installation Costs

Costs of EVSE installation vary widely depending on site and the quantity and type of EVSE being installed. During the installation process, a contractor will procure the EVSE unit(s), install a new or upgraded electrical service or connect the EVSE to an existing electrical service that will accommodate the EVSE load, install the EVSE equipment and re-stripe parking spaces as necessary to fulfill the ADA parking requirements. The local electric utility may need to be involved if the necessary electrical supply upgrades to the facility are considerable (e.g., higher capacity supply wires, transformers, etc.).

The different components of commercial EVSE costs include the equipment price from the vendor and installation, which can include the following items:

- Power connection to the electric grid, including any electric upgrades, circuit components and conduit runs necessary to reach the equipment
- Mounting solutions
- Protective devices, such as bollards or wheel stops
- Wayfinding signage, parking lot lines and stripes
- Lighting
- Internet connection if cellular data service is not available
- Labor and materials
- Permitting, if applicable



Operations and Maintenance Costs

The cost of operations and maintenance will also vary greatly depending upon the level of equipment chosen and software package included. EVSE operational costs can include:

- Electricity consumption and demand charges
- Software and network subscriptions
- Station management, such as billing, customer support, etc.
- Site rental or lease (if not owned)
- Preventive and corrective charging station maintenance
- Repairs

The most common maintenance issue is damage to the cords and/or J1772 connectors, particularly for outdoor charging stations. EVSE units with advanced features or communications systems may require more periodic maintenance than a basic unit simply because there are more components that have the potential to malfunction. Extended warranties and other options made available by the EVSE manufacturers can reduce the long-term maintenance and repair costs.[11]

Electricity Consumption Charges

EVSE operating costs include the cost of electricity to charge the vehicles. In general, the annual electricity consumption cost for a charging station owner is determined based on the electricity rate measured in dollars per kilowatt-hour ($/kWh) and the amount of electricity consumed. The electricity consumption will vary based on the number of vehicles using the charging stations, power output of the stations, climate, the rate at which a vehicle's battery can charge and the amount of time the vehicles charge.

Electricity Demand Charges

In addition to electricity consumption, many commercial and industrial facilities may be subject to power demand charges from the utility, particularly if the facilities have multiple charging stations. At many sites, demand charges can be avoided by strategically managing the charging stations' energy consumption, such as charging at off-peak times or staggering vehicle charging during high consumption periods.

Some EVSE models come with energy management features. These stations can split the energy use among vehicles, or limit or even stop charging during peak demand times to ensure the facility avoids demand charges. Energy management can be especially useful for fleet applications. While the additional energy management will likely result in higher up-front costs, the site host could save money over time depending on their charging needs. It is recommended that potential charging station site owners contact the electric utility prior to installation to obtain information regarding demand charges and how they may be minimized or eliminated.

[11] https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf

10 Steps to Installing EV Charging Stations

Now that you have a better sense of electric vehicle charging technology, charging installation requirements, and other factors around EV charging, what are the next steps? Here are some steps to take to get on the road to installing EV charging and planning for the future.

Step 1

Review this guidebook and answer the "Questions to Consider". Determine what type and how many charging stations you want to install, who will use them, and what features you need in a station.

Step 2

Understand local permitting requirements by researching your municipality or county codes. It may be helpful to contact local government officials. This includes considering accessibility guidance and requirements.

Step 3

Choose your site. The best placement for an EV charging station is in an area of high use. Make sure the site is well-lit and perceived as a safe environment.

Step 4

Identify your needs by choosing between Level 1, Level 2 or Level 3/DCFC. Also consider the need for additional meters, electrical upgrades and pricing if you decide to charge a fee for charging.

Step 5

Decide on a budget for your project, including the considerations of charging type, brand and networking fees, utility considerations and a business model for charging a fee.

Step 6

Plan for future EV installation by assessing future needs and electrical capacity. Consider EV readiness and EV capability installations.

Step 7

Conduct a site assessment. Work with a certified charging station installer or an electrician to evaluate your electrical service and distribution capacity at your property, as well as the best placement for the stations. Obtain price quotes.

Step 8

Create a maintenance and operations plan to ensure the station is consistently operational.

Step 9

Think about where to place directional signs and how many.

Step 10

Install charging stations, spread the word and get charging!

Glossary

CHARGING PORT: The plug that provides a vehicle with electricity.

CHARGING STATION: The entire unit providing EV charging, including plug, networking screen, and payment system.

DEMAND CHARGES: Surcharges on electricity consumption at specific times of day when demand is highest and stress on the grid is greatest. Demand charges are typically applied only to commercial properties but can have significant impact on electric vehicle charging, especially in fleet applications.

NETWORKING: Remote connection to a larger network, such as the cell phone network. This allows a charging station host to collect fees and data on usage of the charging station. Networking has an associated fee, typically several hundred dollars.

VEHICLE ROTATION: Encouraging users to vacate an electric vehicle charging space when their vehicle has finished charging.

Acronyms

AC: alternating current

ADA: Americans with Disabilities Act

BEV: battery electric vehicle

CCS: combined charging system

DCFC: direct current fast charging

EV: electric vehicle

EVSE: electric vehicle supply equipment

KWH: kilowatt-hour

PHEV: plug-In hybrid electric vehicle

RFID: radio frequency identification

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