2022

Raleigh's EV-Ready Playbook

A Guide for Charging Station Preparation, Installation and Management

This document was prepared by Advanced Energy in collaboration with the City of Raleigh's Office of Sustainability.

Thanks to all of the organizations and municipalities that provided input throughout its creation. A special thanks to:

Duke Energy

North Carolina's Clean Cities Coalitions

North Carolina Clean Energy Technology Center

North Carolina's Electric Cooperatives

Plug-in NC's Steering Committee

Southeast Sustainability Directors Network & Local Governments throughout North Carolina

Southern Alliance for Clean Energy

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Acronyms and Abbreviations

ADA:	Americans with Disabilities Act
ADU:	Accessory Dwelling Unit
ANSI:	American National Standards Institute
BEV:	Battery electric vehicle
CMAQ:	Congestion Mitigation and Air Quality
EV:	Electric vehicle
EVSE:	Electric vehicle supply equipment
FHWA:	Federal Highway Administration
GHG:	Greenhouse gas
kW:	Kilowatt
kWh:	Kilowatt-hours
MUTCD:	Manual on Uniform Traffic Control Devices
NCBC:	North Carolina Building Code
NCSU:	North Carolina State University
NEMA:	National Electrical Manufacturers Association
PHEV:	Plug-in hybrid electric vehicle
TOU:	Time-of-use
Wake Tech:	Wake Technical Community College
ZEV:	Zero-emission vehicle

Introduction

This playbook was developed by the City of Raleigh's Office of Sustainability and Advanced Energy, a nonprofit engineering and energy consulting firm. It is intended to support residents, homeowners, developers, electricians, municipal entities, property managers, homeowners associations, public staff, workplaces and business owners by providing the necessary information and considerations for planning, designing, building and installing charging stations in the City of Raleigh and throughout North Carolina.

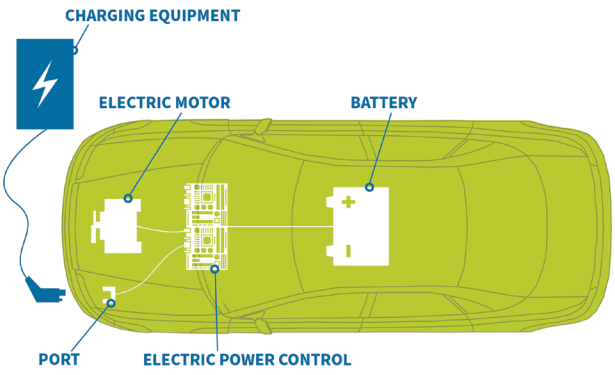
Electric Vehicles

What are electric vehicles?

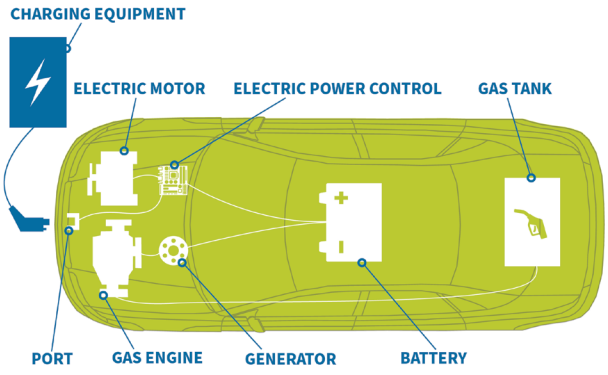
The term "electric vehicles" or "EVs" typically refers to two types of vehicles: battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). EVs are also classified as zero-emission vehicles (ZEVs) because they do not produce tailpipe emissions when running on electricity.

- BEVs are powered solely by an electric motor with a battery pack. This battery pack is charged by plugging into the electric power grid and through regenerative braking, which is the capture of energy that is normally wasted when decelerating.
- PHEVs are powered by a combination of a gasoline engine and an electric motor with a smaller battery pack. These vehicles can run on gasoline or electricity, with the battery pack similarly charged by plugging in and through regenerative braking.

EVs are typically contrasted with traditional hybrid electric vehicles. Hybrid electric vehicles, like PHEVs, are powered by a combination of a gasoline engine and an electric motor with a battery pack. However, their battery pack is smaller and can be charged solely through regenerative braking. The vehicles themselves are fueled only with gasoline and therefore are not considered EVs. The easiest way to think about whether a vehicle counts as an EV is whether it plugs in.



Battery Electric Vehicle



Plug-In Hybrid Electric Vehicle

Figure 1. Inner workings of BEVs and PHEVs. Source: Advanced Energy

Electric Vehicle Adoption Is Rapidly Growing

EV adoption is gaining momentum throughout the country and in North Carolina. Several factors are contributing to this growth.

Auto manufacturers — both traditional and startup — continue to make commitments to electrify their offerings, and these offerings are getting better. EV driving range is improving, with most new models able to travel more than 200 miles on a single charge, and some surpassing 500 miles. In addition to the technology advancing, it is also getting cheaper. For example, the battery packs used in EVs dropped in price **89% from 2010 to 2021**.

More consumers are recognizing the benefits of EVs, too — the cost savings, enhanced performance, reduced environmental impact and more — and **expressing interest** in owning them. EVs generally cost less to operate than gas-powered vehicles because electricity is cheaper than gasoline and because EVs have substantially fewer moving parts. To estimate fuel savings, **Plug-in NC** offers a calculator that allows users to modify relevant inputs (daily miles driven, gasoline vehicle miles per gallon, average cost of fuel, EV miles per kilowatt-hour [kWh] and average cost of electricity).

> **"Our operating costs have dropped by about 2/3 and maintenance costs have essentially been zero."**
>
> **-Matt Allyn, Raleigh EV Driver**

EVs are primed to play a key role in meeting government regulations on emissions and the environment. For example, **Executive Order 80**, issued by Gov. Roy Cooper in October 2018, sets out for North Carolina to increase its number of registered ZEVs to at least 80,000 and reduce its statewide greenhouse gas (GHG) emissions to 40% below 2005 levels by 2025. In 2022, Gov. Cooper further committed to these ambitions by issuing **Executive Order 246**, which calls for at least 1.25 million EVs registered in North Carolina and for 50% of new vehicle sales to be zero-emission by 2030.

> **"I like the silent, powerful electric car so much, I don't think I will ever purchase an internal-combustion car again."**
>
> **-David Strevel, Raleigh EV Driver**

The same is true on a local level. Municipalities across North Carolina, including Raleigh and Charlotte, the two largest cities in the state, are seeking to encourage transportation electrification as a way to achieve climate and sustainability goals. Raleigh, as an example, has a community-wide GHG emissions-reduction goal of 80% by 2050. Transportation and land use account for 42% of total emissions, and the macro-adoption of EVs is among the single most effective strategies to reduce GHG emissions.

With the expansion of EVs, more homes and businesses of all types will be looking to add charging stations, EVs' source of power. Once viewed as an amenity, charging stations will soon become expected by residents, employees, tenants and customers. Retail locations, hospitality, tourist attractions, town centers, apartment complexes, and parks and recreation areas can benefit from installing charging infrastructure, which can drive business and support sustainability initiatives.

According to the City of Raleigh's **Transportation Electrification Study**, released in November 2019, Wake County will need 1,600 Level 2 plugs by 2030 to provide sufficient charging access for EV-driving residents and visitors.

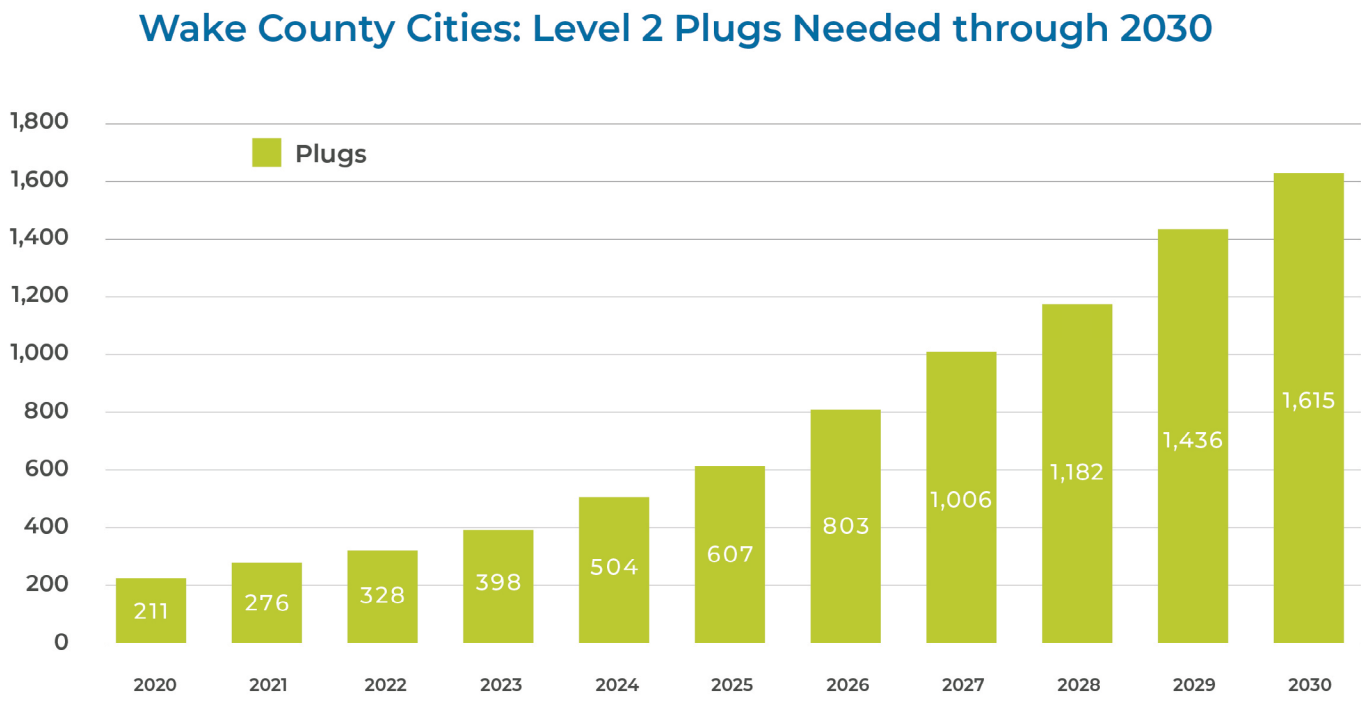


Figure 2. Source: Electrification Coalition analysis based on data from the U.S. Energy Information Administration and U.S. Department of Energy

Electric Vehicle Supply Equipment (EVSE) Installation Guide

Charging stations, also referred to as electric vehicle supply equipment (EVSE), vary in physical appearance, software interface, charging level (which relates to charging speed), cost and installation complexity. In other words, there is no one-size-fits-all approach to EV charging, and chargers can be installed wherever vehicles park.

Charging stations dispense power, measured in kilowatts (kW), to EV batteries that are sized based on their storage capacity, measured in kWh. The delivery of kW over any period replenishes an EV's battery. Two rates dictate how quickly a vehicle can charge: the charging rate of the station, known as the "charging rate," and the rate at which the vehicle can accept charge, its "acceptance rate." Typically, the amount of power that is delivered is the lower of the two. For example, an EV might have a maximum acceptance rate of 125 kW. When charging at a station with a charging rate of 150 kW, however, it would not be able to take advantage of that power. **This article** from Plug-in NC describes charging rates in more detail.

Charging rates are commonly grouped into different charging levels that help drivers and station installers understand the electrical considerations and speeds. Costs for hardware, software and electrical infrastructure depend greatly on charging level. A table of these levels and their expected speeds is shown below:

Level 1

Voltage:

120V 1-Phase AC

Amps:

12-16 Amps

Charging Load:

1.4-1.9 kW

Charging Time:

3-5 Miles per Hour

Level 2

Voltage:

208V or 240V 1-Phase AC

Amps:

12-80 Amps (Typ. 32)

Charging Load:

2.5-19.2 kW (Typ. 6.6)

Charging Time:

12-60 Miles per Hour

DC Fast Charge

Voltage:

208V or 480V 3-Phase AC

Amps:

>100 Amps

Charging Load:

50-350 kW

Charging Time:

100-300 Miles in 30 Minutes

Figure 3. Characteristics of EV charging levels. Source: Advanced Energy

	Level 1	Level 2	DC Fast Charge
			
Most Suitable for	Residential charging, possibly workplace	Single-family residences Multi-unit dwellings Retail Public parking Workplaces Hospitality	Convenience charging while on longer trips Locations near highways and interstate corridors
Pros	Can use any existing wall outlet No necessary electrical upgrades	Very convenient May be free to use in some public settings Low electricity demand concerns for site hosts	Quickest refueling
Cons	Slowest refueling	May require electrical upgrades Has variable costs associated with installation and operation	Usually more expensive to charge ($/hour, $/kWh) Significantly more expensive to install Higher impact of demand charges for station owner/host
Install if	You are an EV driver who has a low-mileage commute, access to Level 2 charging elsewhere (workplace, public) or a PHEV	You are an EV driver who has a higher-mileage commute or are looking for faster charging at home You are a local government, employer, public facility or retailer looking to provide an amenity	You are a site host looking for an amenity to market to customers

Table 1. Use case considerations of EV charging levels. Source: Advanced Energy

Preparing for the Future with “EV Make-Ready” and “Future-Proofing”

Key Terms

Make-Ready: Preparing a location (residential or commercial) at the time of construction or major renovation to efficiently add EV charging capabilities and stations at a later time.

Future-Proofing: When installing charging stations at a site, taking steps to prepare that site for additional charging stations to be added later. This typically does not apply to single-family residential settings.

What if I'm not in need of a charging station today but want to plan ahead?

Installing EV charging infrastructure at construction can be **four to six times cheaper** than doing so during a retrofit. There are a few "make-ready" options to consider if you'd like to limit future expenses of installing charging stations.

How can I prepare a location for a future charging station?

When constructing a new residence or doing major renovations to off-street parking areas (like a garage or carport), preparing for an EV can save money compared to retrofitting later. Here are a few options for planning for an EV:

- **EV Capable** (lowest-cost option): Dedicated electrical capacity in the service panel (commonly a 40-Amp breaker for every two EV-capable spaces) and conduit installed to support future EV charging. This does not have the full circuit and wiring installed, but it would allow for EVSE to be more conveniently installed in the future by preventing expensive service and electrical upgrades.
- **EV Ready:** Electrical panel capacity and conduit installed to support future EV charging, as well as full circuit installation, including 208/240V, 40-Amp panel capacity, raceway, wiring, receptacle and overprotection (like for a clothes dryer). While no station is added with this option, it would prevent nearly all electric and site work costs when installing a charging station.
- **EVSE Installed:** The above steps along with installation of a charging station.

EV Readiness

Figure 4. Levels of EV readiness. Source: **Southern Alliance for Clean Energy**

These same measures can be used for public parking facilities, too. Determining the "right" number of charging spots can be difficult. Keep in mind, it's not just about how many EV drivers will use the spots today but also how many will use them in the years to come, considering the expected growth of EVs. Here are a few best practices and recommendations from other municipalities:

- The City of Atlanta **passed an ordinance for 20%** of spaces at new commercial and multi-family structures to be "EV-ready"
- The City of Orlando has **guidelines** that went into effect in January 2022
- The City of Charlotte adopted the following requirements in August 2022 (with an effective date of June 1, 2023):

Total Number of Provided Off-Street Parking Spaces	EV-Capable Spaces	EVSE-Installed Spaces
0-9 spaces	None	None
10-25 spaces	20% of spaces (rounded up)	None
26-50 spaces	20% of spaces (rounded up)	1 space
More than 50 spaces	20% of spaces (rounded up)	2% of spaces (rounded up)

Table 2. City of Charlotte EV-Readiness. Source: **City of Charlotte**

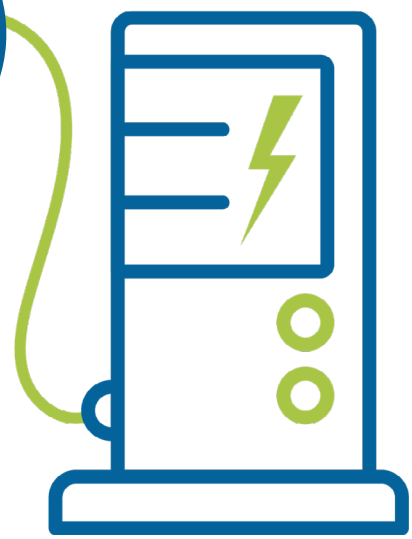
- The City of Denver has provided the following guidance:

	Number of EV-Ready Spaces	Number of EV-Capable Spaces	Number of EVSE-Installed Spaces
1 space	1	None	None
2-9 spaces	1	20% of spaces	None
10 or more spaces	15% of spaces	Remainder of spaces	5% of spaces

Table 3. City of Denver EV-Readiness. Source: **City of Denver**

When installing a station at an existing public or commercial facility, how should you ensure that you're ready to add more stations at the lowest cost in the future?

When installing charging stations, consider the potential for "future-proofing" by having your electrical contractor install conduit for additional stations. This will reduce the need for significant trenching, boring or other site work later and will save costs if future stations are desired.



How much can you save by planning ahead?

While it is difficult to give an accurate price estimate because factors are unique to each jobsite, the City of Denver included the following price estimates in its Building Code Proposal:

EV Infrastructure Requirement	During New Construction	During Retrofit	Savings
EV-Capable (panel capacity + raceway)	$300 per space	$2,500 per space	$2,200 per space
EV-Ready (full circuit)	$1,300 per space	$6,300 per space	$5,000 per space

Table 4. City of Denver EV-ready cost estimates. Source: **Southwest Energy Efficiency Project**

Single-Family Residential Charging Guidance

This section outlines the considerations when thinking about residential charging. Approximately 80-90% of EV charging occurs at home; therefore, this information will be essential for homeowners, residential developers, electricians, property management companies and others looking to add EV charging.

Choose Your Charging Level

What charging level is best for residential use?

In residential settings, the two commonly used charging levels are Level 1 and Level 2. (DC fast charging is generally not suitable for residential locations due to its large power requirements and costs.)

Level 1

Level 1 charging, which uses a standard 120-volt wall outlet, requires no electrical panel or service upgrades. Vehicles are typically stocked with a Level 1 charger when purchased and are ready to plug in — no additional equipment should be needed, making it the cheapest option. Level 1 charging delivers approximately 3 to 5 miles of range per hour. While it's significantly slower than the other charging levels, it may be sufficient for those with short commutes, consistent access to workplace or public charging, or a PHEV.

Level 2

Many drivers, however, opt for a Level 2 arrangement. Level 2 charging is either hardwired or uses a 240-volt outlet (like what is used for a clothes dryer) and delivers 12 to 60 miles of range per hour. Installing a Level 2 charging station often requires the help of an electrician. Depending on the work, panel capacity and upgrades needed, it could cost several hundred to over a thousand dollars. Some electric utilities offer incentives for installing a Level 2 charging station. Check with your utility provider to see if it has any incentives or recommendations.

The image below, from the U.S. Department of Energy, shows the power draw of Level 1 and Level 2 charging relative to other household appliances.

Power Draw for Typical Appliance

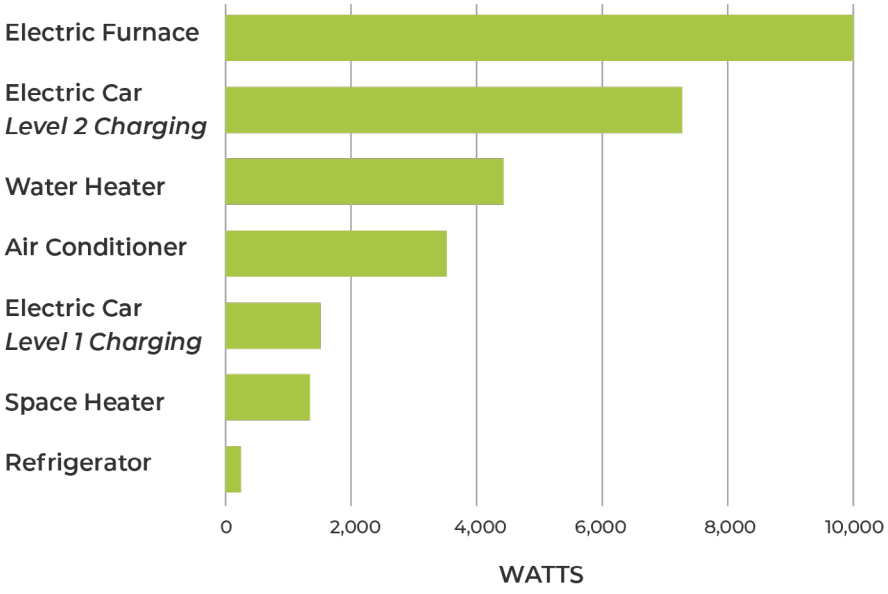


Figure 5. Power draw of common household appliances, including Level 1 and Level 2 charging.
Source: U.S. Department of Energy

Before purchasing and installing a Level 2 charging station, check with your electric utility to see if it offers any rebates or incentives to help offset the cost. Here's a popular one:

Duke Energy Carolinas EV Charger Prep Credit: This program provides $1,117 towards the installation cost as an on-bill credit. Learn more about the program here.

Electric Utility Considerations

How might charging impact my electric bill?

How much your electric bill increases with EV charging will be determined by your driving habits and electric rates. For example, an EV that gets 3.5 miles per kWh and drives 12,000 miles per year would consume approximately 3,428 kWh. At a cost of $0.11 per kWh (Raleigh's average residential rate in 2022), and if all charging was done at home, a homeowner's annual electric bill would increase by about $377. Alternatively, an average gas car that gets 25 mpg and drives those same 12,000 miles would require more than $1,400 in gas (using a price of $2.95 per gallon).

When considering charging at home, see if your electric utility has any rates that support EV charging. As an example, users may be able to take advantage of time-of-use (TOU) rates that offer discounted electricity prices for charging during periods of lower power demand (such as overnight). The following resources can help you explore utility EV programs in North Carolina:

Plug-in NC

Alternative Fuels Data Center

If you're a member of an electric cooperative in the Triangle, here are a few TOU rates that might be for you:

Wake Electric Residential Service with Electric Vehicle Schedule Rate

Monthly service fee, plus:

- All kWh (6am – 10pm)
  10.7 ¢ per kWh
- All kWh (10pm – 6am)
  8.7 ¢ per kWh

Wake Electric Residential Time-Of-Use + Electric Vehicle

Monthly service fee, plus

- On-Peak kWh
  40.0 ¢ per kWh
- Off-Peak kWh
  (see more detail below)
  8.0 ¢ per kWh
- Off-Peak kWh
  (EV discount: 10pm – 6am)
  5.0 ¢ per kWh

Estimated Charging Costs with a TOU Rate:

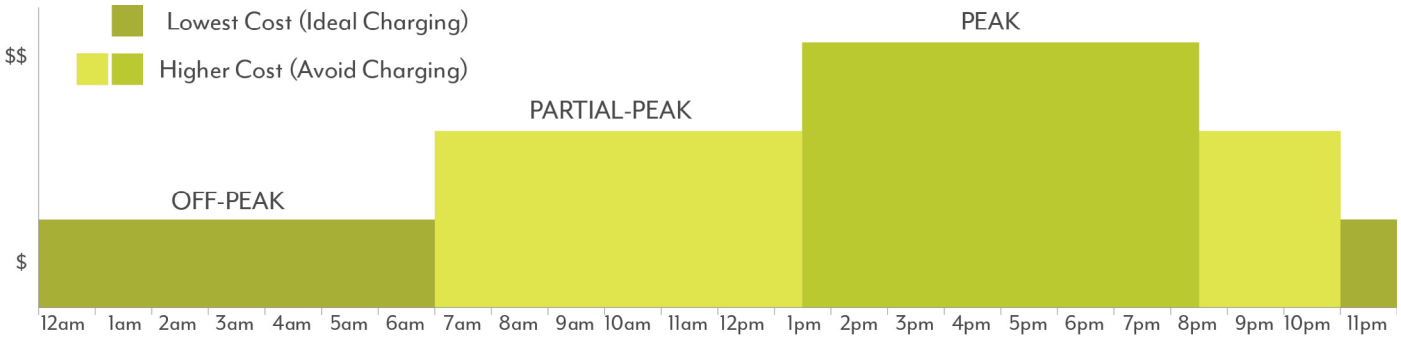


Figure 6. Example TOU charging periods and costs. Source: **Advanced Energy**

When on a TOU rate, charging costs vary based on the time of day an EV is charged. For instance, an example summer on-peak rate in North Carolina is $0.34 per kWh, while an off-peak rate could be $0.07 per kWh. (These prices are estimates only; actual prices are determined by individual electric utilities.) The baseline retail price per kWh is $0.11. If an EV owner drives 40 miles per day at 4 miles per kWh, the vehicle's battery will use 10 kWh each day.

- Estimated cost to recharge 40 miles during a TOU off-peak period: **$0.70**
- Estimated cost to recharge 40 miles during a TOU on-peak period: **$3.40**
- Estimated cost to recharge 40 miles on a standard retail rate (non-TOU): **$1.10**

If you're new to TOU rates, your utility can tell you more about them. It's important to use energy for your home during the off-peak times. Sometimes, you can schedule your car to start charging (even if it's plugged in) through the vehicle's info system or through a networked Level 2 charging station (more on that in the next section).

If a Level 1 charger works for you, you're all set!

Just find a wall outlet and use the plug provided to you by the manufacturer. Note that some manufacturers are no longer providing Level 1 charging cables with vehicle purchases.

If you've decided on a Level 2 charger, keep reading.

Choosing Your Level 2 Station Type

So, you've opted for a Level 2 charging station. What charging connector type should be installed?

In residential settings, there are two primary Level 2 plug types that connect EVSE to an EV: J1772 (for all manufacturers besides Tesla) and Tesla's own connector (specific to Tesla vehicles). Tesla does, however, provide a J1772 adapter for its vehicles, making this connector type the most accessible and universal Level 2 charging option. For this reason, a J1772 connector type is strongly recommended.

Figure 7. Level 2 charging connector types.

Should I install a networked or non-networked station?

Drivers who install Level 2 charging at their residence will need to decide between a "networked" and "non-networked" setup.

Networked chargers, sometimes called "smart" or "connected" chargers, allow for increased functionality compared to non-networked chargers. Common features and benefits include:

- Data Tracking: Offers tracking of kWh used during a session or for a period of time.
- Wi-Fi Connectivity and Scheduling: Allows for scheduling of charging sessions, often from mobile devices. This can be particularly useful for users on TOU rates.

- Advanced Integration with Utility Programs: In addition to TOU rates, some utilities offer more advanced integration with charging stations to help reduce demand during peak energy periods. These programs often come with incentives or bill credits. Check with your local utility to see if it offers any EV-related demand response programs.

Non-networked chargers typically deliver the same power as networked chargers and may be less expensive to purchase but don't offer the Wi-Fi connectivity and functionality. Think of these like older cellphones – they can run for a very long time but don't offer any web connectivity or mobile apps.

Should the station be hardwired? Another important consideration when selecting a Level 2 residential charging station is whether to install a hardwired or plug-in station.

Hardwired stations have conduit running from the station unit and have service wires accessible for installing into a junction box. They are more permanent, though they can be moved with the help of an electrician.

Plug-in stations have no flexible conduit and instead rely on a 240-volt plug for a NEMA outlet. (NEMA ratings correspond to the plug and connector types set by the National Electrical Manufacturers Association. A list of NEMA plugs and receptacles can be found **here**.) There is no standard for 240-volt outlets/plugs, so there are a couple of popular options:

Figure 8. NEMA outlet types. Source: **ClipperCreek**

An electrician can help you identify the NEMA plug you need if you already have a 240-volt outlet for a charging station but do not know which kind it is. If you are installing your station outdoors, hardwiring might be a better option. In some cases, there are adapters for older 240-volt outlets, like NEMA 10-30 or 14-30.

What size dedicated circuit is needed for Level 2 charging? It depends on your electrical panel capacity and charging needs. In many cases, a 40-Amp dedicated circuit will be more than enough. In some scenarios, like if you have multiple EVs, you could consider higher dedicated circuitry. Just keep in mind that faster isn't always better. Your vehicle will have many hours to charge overnight, and you likely won't need to charge from a depleted battery to a full one every night. An electrician will discuss these options with you. If you do not have the capacity in your service panel for a dedicated EV circuit, there will likely be a need and associated cost for installing an upgraded panel. Alternatively, there are products offering "smart circuit breakers" that may help you efficiently manage your dedicated circuits.

Identifying Your Station Location, Placement and Permitting

How do I determine where to install the charging station or outlet?

The first step in assessing your charging placement will be to determine your current or planned parking scenario. For single-family residences with off-street parking, that will likely be one of the following:

Garage

- Simple, most basic installation
- Ideal for Level 1 and Level 2 charging
- Limits exposure to the elements
- Prevents unwanted access

Carport/Driveway

- May have increased exposure to the elements, which could shorten the useful life or functionality
- May not allow for a wall-mounted station type

Placement Best Practices

- If installing a new outlet, choose a place near a frequent parking spot, such as in a garage or carport/driveway. Note the location of the charging port on the EV and whether the driver has a preference to back in or pull in headfirst.
- Typically, residential stations should be wall-mounted if in a garage and pedestal-mounted if in a carport or driveway.
- No matter where the outlet is located, make sure there is available space for the station hardware and cord for installation and storage.
- Make sure the charging cord can be stored securely when not in use, and avoid locations that will require it to be wrapped around or draped over the vehicle. Stations will frequently include a retractable cord or have a feature for hanging the cord on the EVSE.
- Consider whether more EVs will be parking in a garage or space in the future. If so, keep that in mind when placing outlets or upgrading electric service.

For on-street parking, installing charging for a personal vehicle in the right-of-way is limited and difficult to support based on a variety of factors:

- Required permits for use of right of way
- Required approvals by City officials
- Required insurance policies
- Complexity of construction and co-locating with other existing or future utilities
- Public parking space ownership
- Existing City codes
- Obtaining necessary permits

What is the required permitting process for the City of Raleigh to install a station at my residence?

You have done your research, identified the best location for your charging station, decided what hardware you want to use, and are ready to get started. Before beginning construction, you'll need to get the appropriate permits for the work. Below is an overview of the permitting process for the City of Raleigh.

Expect the turnaround time for your permit — from the time it is submitted through review, payment and issue — to be at least 15 to 20 business days. All standard permitting and review

processes are applicable to EV charging stations as well as costs associated with permit review.

Please be aware that there are different permit applications for commercial and residential installations.

During the review process, the permit application will be assessed for electrical, fire, site accessibility, stormwater and zoning. The applicant submitting can be the homeowner, property owner or contractor. Links to all types of permits can be found on the City of Raleigh's website **here**.

All of the information you will need to submit for a residential EV charging station installation can be found on the **Residential Tier One Site Plan Checklist** and **Residential Permit Application**.

What will need to be completed for the permit?

You will need to submit the checklist form, the permit application and the associated documentation included in the checklist.

Residential Tier One Site Plan **Checklist**

- ☑ For Development Type, use the "Other" category and specify "electric vehicle charging station," including clarification on where the EVSE will be located (e.g., existing parking garage).
- ☑ The applicant can be the property owner or the contractor. If you own the property, you may act as your own contractor and complete the installation.
- ☑ Include a site plan showing the existing site and proposed modifications, including where the EVSE will be located and the affected electrical work.
- ☑ The Supplemental Plan Checklist and Supplemental Drawing Checklist are not required.

Residential Permit Application

1. General Information
   - ☑ Check “NC Building Code 2018,” as this is the code that will apply to the project.
   - ☑ Include applicant and property owner contact information.
   - ☑ The applicant can be the property owner or the contractor.
2. Project Information
   - ☑ Choose the “Other” category and specify “electric vehicle charging station.”
   - ☑ Provide a detailed description of the project with EVSE equipment information, including make, model, voltage and manufacturer specifications. Cut sheets of the product can likely be provided by the manufacturer.
   - ☑ Include a site plan showing the existing state of the site and the state of the site following modifications. Include electrical modifications and where the EVSE will be installed.
3. Site Information
   - ☑ Find information about your zoning and overlay districts from tax records or **here**.
   - ☑ “Existing Use” and “Proposed Use” sections are not applicable for this type of project.
   - ☑ “Required parking” is not applicable unless the number of parking spaces will be affected.
   - ☑ If adding impervious surface, such as EVSE mounting pad, indicate added square footage.
   - ☑ It is unlikely that “Building Information” will be required, unless a garage or carport is being added or significantly modified.
   - ☑ Include total construction costs for the project.
4. A wet signature by the applicant is required on this form. Typed font signatures will not be accepted.
5. “Mechanical Equipment Questions” are not applicable.
6. “Accessory Dwelling Unit (ADU) Information” is not applicable.
7. “Residential Infill Compatibility” is not applicable.
8. Include the contact information and license information for the contractors that will be used.
   - ☑ An electrical contractor will likely be completing this work. A building contractor may be included in the project but cannot perform electrical work.
   - ☑ If you are the property owner AND you occupy the dwelling, you may act as your own contractor if you are capable of completing the installation. If you are the property owner and rent or lease the dwelling, you CANNOT act as the electrical contractor.
9. If you are adding an electric meter, a separate permit will need to be submitted (same form, different permit application).
10. “Utility Connection Permit” and “Stub Permit” sections are not applicable. These are for new water or sewer services.

Work with Electrician to Install Station (Level 2 Station)

What steps should I take to install a station?

- Contact a certified electrician.
- Contact your local electric utility. Let them know that you plan to install a Level 2 charging station and ask the following questions:
  - What is the size of the electrical service to the site? (The utility may be able to provide information about the likelihood of needing a service upgrade based on the existing service and the intended number of charging stations.)
  - Are there any incentives or rate structures that may save me money on installation or future electricity costs?
- If a service upgrade is required, a visit from a utility representative may be needed. Coordinate this with your electrician if possible.
- Identify the station location with the electrician. Assess mounting and electrical needs based on location.
- Confirm electrical specifications of desired charging station, safety ratings, weatherization (NEMA) rating and panel capacity with electrician.
- Obtain permit from the City of Raleigh (see information above).
- Purchase charging station.
  - Stations can be bought directly from station manufacturers. Some utilities offer online "marketplaces" that recommend stations to be purchased.
  - Be sure to purchase a station with the proper mounting type for the location you selected.
- The electrician will install station. Some or all of the following steps will be performed:
  - Excavation to prepare for conduit (if necessary) — removal of drywall, pavers, concrete, trenching, boring, etc.
  - Run conduit from the power source to the identified charging location if no existing 240-volt outlet exists
  - Pull wires
  - Mount/place charging station in desired location
- Make sure to follow EV safety protocols based on **Federal Emergency Management Agency recommendations**.
- Charge up!

Public, Workplace & Multi-Family Charging Guidance

Charging stations are a valuable amenity for customers, employees, apartment or town-home residents, and other visitors. EV drivers often decide where they shop, sleep and stop based on available charging. Whether you are looking for a competitive advantage or increasing satisfaction with your employees or community members, charging stations have ever-growing appeal. The information in this section will be essential for commercial developers, electricians, property management companies, business owners, local government officials, employers and others looking to add EV charging.

Ideal Charging Station Locations

Retail

- Restaurants
- Shopping centers
- Groceries
- Malls
- Breweries and wineries

Hospitality

- Hotels
- Rental properties
- Ecolodges
- Campgrounds

Parks & Rec

- Municipal parks
- Trailheads
- State parks
- Beaches

Town Centers & Amenities

- Libraries
- Town halls
- Chambers of commerce
- Downtown businesses

Travel Corridors

- Convenience stores
- Roadside parks
- Rest areas
- Truck stops

Tourist Attractions

- Historical markers and landmarks
- Scenic areas
- Zoos and aquariums
- Museums

What's in it for my business or property?

Puts you on the map, literally!

Apps such as PlugShare show charging station locations and allow drivers to share their experiences.

Increases time spent

EV drivers prefer to spend their charging time at local amenities and nearby businesses.

EV drivers are opportunistic about charging

It's more like charging your phone than refueling. Drivers don't wait to recharge until they are empty. Instead, they look for compelling stops along their route to charge.

EVs align with clean energy efforts

You can establish yourself as a sustainability leader.

EV drivers will target overnight facilities that offer charging stations

Most want to drive their EVs when on vacation, and charging overnight takes advantage of downtime.

Explore incentives

Federal, state and utility funding options could help with charging station purchases.

Choosing Your Charging Level

What charging level is best for non-residential use?

In public settings, charging will either be Level 2 or DC fast charging (see pages 8 and 9 for more information). Level 2 stations attract customers who are willing to spend more time at your place of business or can serve as a valuable amenity. Common locations for Level 2 stations include grocery stores, retail facilities, restaurants, college and university campuses, movie theaters, parks, apartments and other multi-unit residential dwellings, town centers, museums and workplaces. DC fast charge stations are ideal for heavily trafficked corridors, as drivers will look to these stations for a quick charge while on a longer trip.

> **"Occasionally we'll look for areas that have chargers and that will influence our destination. We've selected hotels based on availability of charging."**
>
> -Matt Allyn, Raleigh EV Driver

Electric Utility Considerations

How might charging impact a site host's utility bill?

A site host is the entity that has a station installed on its property. This could be the owner of a retail parking lot, municipality, retailer, etc. How much your electric bill increases will depend on a number of factors, such as the number of stations and amount of usage (i.e., the stations' utilization). It will be best to discuss this topic with your electric utility and, possibly, charging station vendors.

Another important element is a demand charge. Demand charges are a pricing component often found on electric bills to cover the cost of equipment needed to serve a specific customer. They are typically set by the highest single use of electric demand during a particular period. With EVs, they are especially critical when considering DC fast charging, which can currently provide up to 350 kW of power output. Check with your utility about your demand schedule and the impacts from high-powered DC fast charging.

TIP **Engage with your electric utility early and often**

What is the typical cost for different station levels?

The cost for single-port EVSE varies greatly and depends on a number of factors. General cost range estimates are shown in Table 5.

Type of Charging	Unit Cost Range	Installation Cost Range
Level 1	$300 to $1,500	$0 to $3,000
Level 2	$400 to $6,500	$600 to $12,700
DC Fast Charging	$10,000 to $40,000	$4,000 to $51,000

Table 5. Cost ranges for single-port EVSE. Source: City of Raleigh Transportation Electrification Study

Choosing Your Station Type

What connector type should be installed?

For Level 2 charging, there are two primary plug types that connect EVSE to an EV: J1772 (for all manufacturers besides Tesla) and Tesla's own connector (specific to Tesla vehicles). Charging stations that are not Tesla chargers will use the J1772 plug type. This is the most universal plug type for Level 2 charging and is strongly recommended by the City of Raleigh for those installing a public charging station. Tesla vehicles are able to charge using J1772 connectors with an adapter.

Figure 9. Level 2 charging connector types.

Recommendation: When installing a Level 2 charging station, opt for a J1772 plug type to ensure that there are no proprietary limitations and that all vehicle models can access the technology.

There are three main DC fast charging connector types. Which connector a vehicle uses depends on its manufacturer. Tesla connectors, for Tesla vehicles, are found at the manufacturer's Supercharger locations. CCS and CHAdeMO connectors are deployed by most other DC fast charge station providers. Although there is no universal DC fast charge plug standard, CCS is becoming the preferred type.

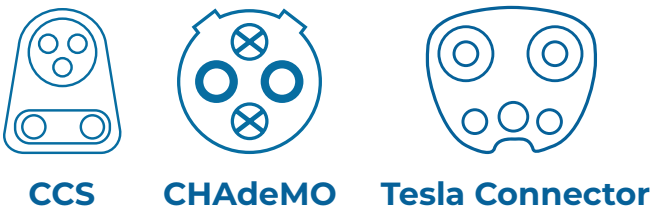


Figure 10. DC fast charging connector types.

Should I install a networked or non-networked station?

For site hosts opting for Level 2 stations, another determination is whether to install a networked or non-networked station. (Today, all new DC fast charge stations are networked, so no determination needs to be made.) Both can deliver similar power output (so the charging times are the same), but they differ in their functionality.

TIP

The needs for networking might depend on your facility/site type and who will be using the stations. Keep this in mind as you read on.

Networked charging stations for public and commercial use are designed with interoperability standards that allow for communication between charging stations and are configured with a central network system. Some features and benefits of networked charging stations include:

- Data Insights and Station Configurations: Hosts can use software dashboards and websites to see usage statistics, such as kWh, charging sessions, charging durations, GHG reductions, etc.
- Driver Notifications and Interactions: Drivers can be notified when it is their turn to charge and when their charging session is complete.
- Operation and Management: Site hosts can manage access for time of day, charging output and RFID activation.
- Charge to Charge: Site hosts can set fees for station access, which can be used to recover some, or all, of the cost of electricity for vehicle charging or to mitigate some of the operational costs and service for the station.

Non-networked stations typically deliver the same power as networked chargers but don't offer the Wi-Fi connectivity and functionality. For this reason, they are typically lower cost, easier to install and operate, and more durable.

Selecting the station that's right for you, final considerations:

- Maintenance and Networking Fees: In addition to their purchase price, networked stations have ongoing maintenance and/or networking costs for their connectivity (similar to data plans for cellphones).

- To Network or Not to Network? Site hosts will need to determine whether the increased functionality of networked stations warrants their higher cost. Ask what you want to achieve with your charging station. If offering a simple amenity for customers, employees or visitors is most important, networked stations may not be necessary.

Open Charging Standards

To increase the flexibility and strengthen the longevity of your charging solution, look for vendors that are compliant with the Open Charge Point Protocol (OCPP).

OCPP is a protocol allowing for open, interoperable communication and compatibility across the components of EV charging: the vehicles, the charging hardware, the charging software and the grid. The freedom it affords can benefit customer satisfaction and reduce the likelihood that your charging station becomes a stranded asset. With OCPP, charging station owners can choose from and switch between network providers without needing to significantly upgrade existing hardware.

See Electrify the South's Electric Transportation Toolkit for more information.

Should a site host charge to charge?

Typically, EV drivers are comfortable with paying a competitive, fair market rate for a charging session. If you are planning to host a DC fast charger on your property, it is strongly encouraged to charge users to plug in to offset the high operational and installation costs.

For Level 2 charging, charging a fee for access is a bit more flexible. Many site hosts opt not to charge a fee in an attempt to share their stations as an amenity for any services offered at the location. This is especially true for workplaces looking to offer a competitive amenity to their employees. However, in other cases, charging a fee for Level 2 charging can be encouraged. Some reasons for this include:

- Paid stations encourage drivers to move their vehicles after finishing a charge instead of sticking around and blocking stations for others
- Paid sessions can offset some of the ongoing costs for operating the station, including networking fees, demand charges and infrastructure updates
- Charging fees can be seen as more "fair" if you're offering this amenity to tenants or employees

Here are a few approaches to charging station pricing:

- A fixed fee for the entire charging session
- A per-hour fee for charging
- A variable per-hour fee for charging: This allows the site host to use price signals to encourage drivers to move their vehicle after a few hours. An example would be, "$2/hour for first 3 hours, then $7/hour" – also called dynamic pricing
- A per-kWh fee: This allows the site host to charge a fee per kWh. Because different vehicles charge at different rates, this pricing method is seen as the fairest
- A variable per-kWh fee: Much like the variable per-hour fee, this allows price signals to be sent to the driver after a certain amount of kWh has been delivered

Third-party companies often manage any credit card transactions and process payment for charging stations. Be sure to speak with potential station vendors about pricing options and recommendations based on your needs.

Remember, charging a fee for a charge can only be conducted with networked charging stations.

Which mounting types should be considered?

Wall-mounted stations are typically used in parking garages or placed on the side of buildings that have smaller parking lots or shorter distances from the parking lot to the facility.

Pedestal- or pole-mounted stations are commonly found in parking lots that do not have structure or facility walls close by. A pedestal-mounted station from North Carolina State University is shown here.

Figure 11. A Level 2 charging station on NCSU's Centennial Campus. Source: Advanced Energy

Identify Your Station Location and Placement

Where is the best location for the charging station?

Optimal siting for charging stations depends largely on the use case and desired outcomes of the site host. For example, apartment buildings, retail facilities, schools, parks and municipal town centers may prefer to have charging located conveniently to the facility. However, siting too close to the facility (i.e., making the parking space too convenient) may increase the likelihood that stations become occupied by non-EV drivers due to their desirable location. Proximity to a power supply should also be considered. The further a station is from a source, the higher the potential material and installation costs. Consult with a utility representative and electrical contractor before making a final decision.

Visibility should be an additional consideration, locating chargers where they can be seen by drivers when possible. Charging stations should be located in areas with sufficient lighting for driver safety and comfort. Increasing visibility also helps promote awareness for EV drivers both current and future.

Similarly, workplaces may want to install stations in places that are convenient for drivers but that don't give non-EV-driving employees an impression of "unfairness" with a parking amenity. Organizations that are including EVs in their fleets may not have concerns about placement, other than choosing the most-strategic location for optimizing access and convenience for EV drivers. The City of Raleigh is currently working on standardizing best practices for EVSE and related infrastructure. For the latest information, please visit the **City website**.

How should the stations be protected from inadvertent collisions?

Curbs, bollards and wheel stops may be used to protect charging hardware and/or delineate an accessible route. The style of protection will depend on the site details and mounting type. Any of these protection devices may also obstruct access, introduce a trip hazard or make it more difficult to establish an accessible route from the charging space to the charging hardware.

How can the stations be protected from environmental exposure?

If installing in a parking lot that is partially or completely exposed to natural elements, **weatherproof enclosures** are needed. Charging station providers almost always provide such products as standard offerings.

Before installing a station, notice if the desired location has any **standing water after rain events**. If so, make sure the equipment is sufficiently elevated to avoid damage. Find out if you are in a floodplain or flood-prone area using the **City of Raleigh website**.

TIP

Do you already know the station provider you would like to select for your charging station? Great! Usually, they will have multiple mounting options available for each model.

How does a station stay orderly?

Many stations have integrated cord-management features. Pedestal-, bollard- and pole-mounted stations often have retractable mechanisms to keep the cords off the ground while being convenient and easy to use. Wall-mounted systems can typically store charging cords by wrapping them neatly around the station or an integrated hook.

Retractable cords prevent tripping hazards and reduce damage from vehicles driving over cords that might otherwise not be properly returned to the station. However, they can create a "clothesline" hazard in pedestrian areas. Loose cords can be wrapped around a hook located at the station (similar to a garden hose). This method does not use a retractable cable, which reduces costs and possible equipment malfunctions if the mechanism breaks, but requires users to replace them at the station after charging. While plugged into a vehicle, the cord may create a tripping hazard, especially in pedestrian areas.

Best practices for identifying charging station locations:

- Placing all stations in a single area will reduce the overall cost of installation
- Spots of high visibility could help encourage EV adoption and increase station utilization
- Wall-mounted stations are often preferred in parking garages due to the ease of conduit being run along the walls (as opposed to groundwork)

How should a charging station be marked for drivers?

While it is not mandatory at this time, the City of Raleigh recommends that a parking space designated for EV charging be indicated by vertical signage identifying the station as such and that parking is only for EV charging. According to the U.S. Department of Transportation Federal Highway Administration (FHWA), there are no standards on charging station signage; however, the FHWA has released guidance on **recommended signage and specifications**.

The following image is not a required EV parking sign for the City of Raleigh, but it is often used by charging station site hosts:

Figure 12. Example signage for EV parking. Source: City of Raleigh

When creating and placing signage, follow all guidance set in the Manual on Uniform Traffic Control Devices (MUTCD). The MUTCD offers **sign specifications** that can be used, as well as **guidance on placement and clearances**.

In addition to signage at the charging station location, there may be a desire to incorporate wayfinding signage to allow drivers to locate a charging station from a highway or other traffic corridor. According to the **Alternative Fuels Data Center**, the FHWA has approved

the following designs for charging station wayfinding signage. Contact the North Carolina Department of Transportation for more information on this signage.

Figure 13. Wayfinding signage for EV charging. Source: **Alternative Fuels Data Center**

What considerations are needed to ensure accessibility for all?

As municipalities and businesses install publicly available charging stations, an important design requirement is to ensure accessibility for users with disabilities. In the U.S., the accessibility of public facilities is mandated by the Americans with Disabilities Act (ADA), which was passed by Congress in 1990 and amended in 2008. ADA protects the civil rights of people with disabilities in many aspects of public life.

In July of 2022, the **U.S. Access Board**, an independent federal agency that issues accessibility guidelines under laws such as ADA, authored a **technical document** to assist in the design and construction of EV charging stations to ensure accessibility to people with disabilities.

The City of Raleigh recommends that EV charging station site hosts work with station providers, installation contractors and designers (if a new parking facility) to comply with the specifications outlined in the Access Board's document. It should be noted, however, that this document does not offer prescriptive guidance on every topic related to accessibility, so some local jurisdiction and state-specific interpretations may be necessary.

According to the Access Board, two aspects of EV accessibility need to be considered:

- **Accessible Mobility Features**: A reasonable number of chargers must have physical access for people who use mobility devices. The primary concerns include the size of the vehicle charging space, access aisles, the location of the station relative to the charging space and the physical operability of the charger. There is no mandate from the guidance document on the number of accessible chargers; instead, under ADA standards, access to a "reasonable number" is required. The Access Board aims to solicit comment and provide future direction on this topic.

- **Accessible Communication Features**: All EV chargers should have accessible communication features, allowing for use by people who are deaf or hard of hearing and by others with disabilities who do not need accessible mobility features. The technical assistance document references features such as electronic user interface, card readers and payment systems, and connectivity.

Number of Accessible Spaces: Currently, no explicit requirements exist regarding the number of charging spaces that must be accessible; however, it is recommended to follow the requirements for standard and van-accessible parking spaces presented in North Carolina Building Code (NCBC) **Table 1106.1 and Section 1106.5**.

It is not recommended to mark accessible charging spaces for the use of only disabled-marked vehicles because:

- The primary purpose of charging spaces is vehicle fueling; and
- The installation of accessible charging spaces does not reduce the number of required accessible parking spaces at the same site.

Marking Spaces: A site owner may choose to install charging hardware at a marked-accessible parking space or to install it such that it can be shared between a marked-accessible parking space and another charging space. In such cases, the primary purpose of the marked space would remain the parking of disabled-marked vehicles. Such installations may be interpreted as satisfying the requirement for accessible charging spaces. In these situations, the North Carolina Department of Insurance recommends that signage be provided to clarify that charging is not required to use the space. For example, "Accessible Parking. EV Charging Is an Accessory Use" or "EV Charging Optional."

Total Charging Spaces	Total Accessible Charging Spaces	Van-Accessible Charging Spaces
1-25	1	1
26-50	2	1
51-75	3	1
76-100	4	1
101-150	5	1
151-200	6	1
201-300	7	2

Table 6. Requirements for standard and van-accessible parking spaces. Source: North Carolina Building Code

Van Accessibility and Accessible Routes: The first charging space that is installed should be sized for van-accessibility. A second accessible charging space is recommended when the 26th charging space is installed. That second accessible space should be sized as a standard (non-van) accessible space. At least one out of every six accessible charging spaces should be sized for van-accessibility.

In some designs, a facility owner may install charging hardware such that it can be shared by a standard charging space and an accessible charging space. Such installations may be interpreted as satisfying the requirement for accessible charging spaces.

In multi-level parking structures, all charging spaces may be located on one level. In parking facilities for buildings with multiple accessible entrances, charging spaces are not required to be dispersed. However, if charging spaces are provided in multiple locations for buildings with multiple accessible entrances, accessible charging spaces must be provided at each location.

There is an exception to NCBC 1106.1 for certain types of fleet vehicle and motor pool parking facilities where lots accessed by the public are provided with an accessible passenger loading zone. Accessible passenger loading zones are addressed in NCBC 1106.7 and ANSI 503. The basic requirements include a pull-up space that is a minimum 8 feet wide by 20 feet long with an adjacent access aisle that is a minimum 5 feet wide by 20 feet long, marked so as to discourage parking in the aisle.

While any requirement for an accessible route from an accessible charging space to an associated building may be subject to interpretation, it is clear that there must be an accessible route between the charging space and the charging hardware. The goal is to ensure that once an EV is maneuvered into the space, the driver can connect the charging cord to the vehicle charging inlet. It is acceptable for the driver to place the charging cord in or along that accessible route for the duration of the charging process. Please refer to the **U.S. Access Board document** for more information on accessible route design for EV charging stations and building access.

Below is a proposed charging station layout:

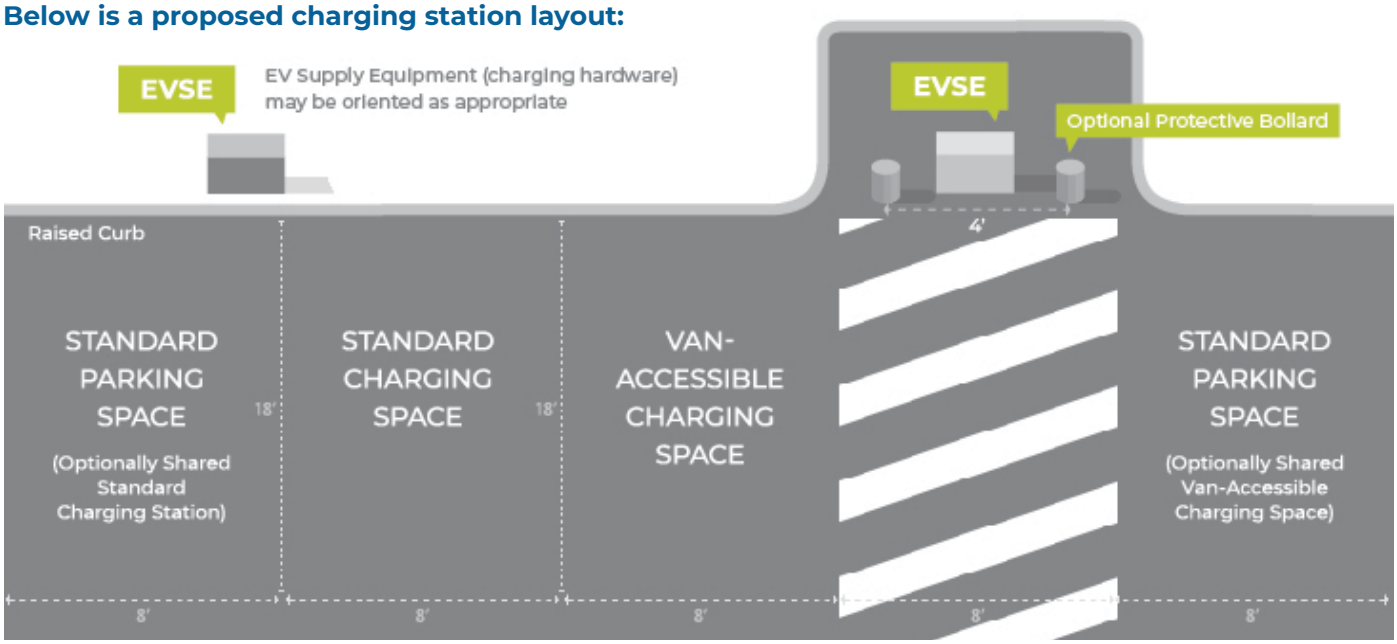


Figure 14. Example charging station layout. Source: Advanced Energy

Charging Equipment Accessibility

- Charging cables should not be more than 48 inches above the installed surface area. The diagrams below show reach range requirements.

Unobstructed high forward reach range of 48 inches:

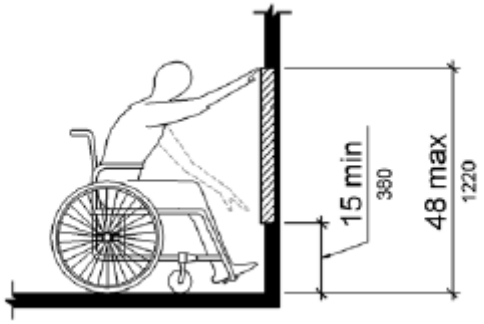


Figure 15. Unobstructed forward reach range requirement.
Source: ADA

Obstructed high reach range:

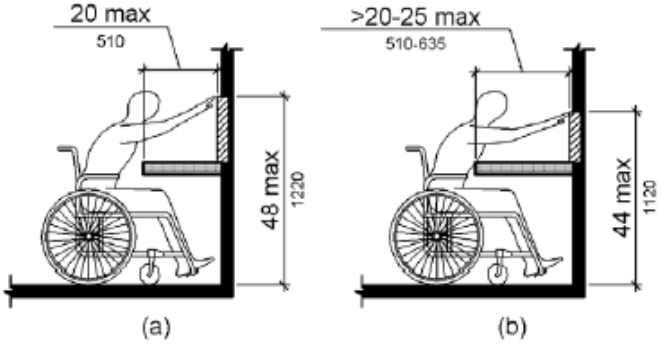


Figure 16. Obstructed forward reach range requirement.
Source: ADA

- Charging handles should not require undue strength to lift and operate.

Obtaining Necessary Permits

What is the required permitting process for the City of Raleigh to install a public or commercial charging station?

You have done your research, identified the best location for your charging station(s), decided what hardware you want to use, and are ready to get started. Before beginning on construction, you'll need to get the appropriate permits for the work. Below is an overview of the permitting process for the City of Raleigh.

Please be aware that there are different permit applications for commercial and residential installations.

Expect the turnaround time for your permit — from the time it is submitted through review, payment and issue — to be at least 15 to 20 business days. All standard permitting and review processes are applicable to EV charging stations as well as costs associated with permit review. During the review process, the permit application will be assessed for electrical, fire, site accessibility, stormwater and zoning. The applicant submitting can be the property owner or contractor.

Links to all types of permits can be found on the City of Raleigh's website **here**.

Non-Residential Permitting

Complete and submit the **Non-Residential Permit Checklist** and the **Non-Residential Permit Application**.

Completing the Non-Residential Permit Checklist

1. Be sure to include the following:
   - ☑ Site plan showing existing and proposed states of the site
   - ☑ Engineered electrical plans
   - ☑ Building code summary on plans
   - ☑ Cut sheets from hardware manufacturer with engineer validation
   - ☑ Power riser information
   - ☑ Certificate of appropriateness if located in historical district
   - ☑ Right of way encroachment if necessary

Completing the Non-Residential Permit Application

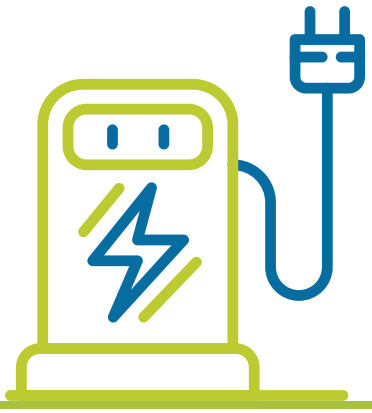
1. General Information
   - ☑ Include applicant and property owner contact information.
   - ☑ The applicant can be the property owner or the contractor.
   - ☑ Include property information, including address.
   - ☑ Check the box for 2018 NC Building Code. This building code applies to the project design.
2. Project Information
   - ☑ Commercial Review type is recommended.
     - Pony Express is not available for EVSE projects.
   - ☑ Work Type would qualify as “Alteration/Repair.”
   - ☑ Provide a detailed description of the project, including as much information as possible about the charging station hardware, manufacturer specifications, the location of the charging station, how it will be mounted and other relevant information. Hardware cut sheets should be provided as an attachment.
3. A wet signature is required on this form. Typed font signatures will not be accepted.
4. Additional Project Information
   - ☑ Find information about your zoning and overlay districts from tax records **here**.
   - ☑ “Existing use” and “Proposed use” sections are not applicable for this type of project.
   - ☑ If adding impervious surface, such as EVSE mounting pad, indicate added square footage.
   - ☑ It is unlikely that “Building Information” will be modified, but include any proposed modifications.

5. Mechanical Equipment Questions are not applicable.
6. EVSE projects will not affect Residential Infill Compatibility.
7. EVSE projects should include electrical contractor information. If modifications to the parking facility are required, such as structures, include building contractor. Building information is not required if the EVSE is located in a parking lot. Other trades, such as plumbing and mechanical contractors, are not applicable for these types of projects.
8. You will likely want to post signage identifying parking spaces for EV charging. Complete the section for Signs.
    - Permitting information for signs can be found on the **City of Raleigh website**.
9. If you are adding an electric meter, a separate permit will need to be submitted. Same form, different permit application.
10. No entries need to be made in the Utility Connection or Utility Service sections.

Work with Electrician to Install Station

What steps should I take to install a station?

- ☑ Contact a licensed electrical contractor
- ☑ Begin prep work: The site host and contractor should work together to:
  - Confirm ownership of the site (not just the facility, but the physical location in which the charging stations will be installed)
  - Contact the desired charging station vendor to confirm:
    - Make and model
    - Features of interest
    - Electrical specifications
    - Communications requirements (if networked stations)
  - Identify parking location of the station
  - Confirm preferred mounting type for identified location
  - Contact local electric utility and ask the following questions:
    - Are there incentives or rate structures that would save on station installation or ongoing electricity costs?
    - What is the size of the electrical service on site? Would a service upgrade be needed with the addition of the charging stations?
      - Is a service upgrade or new meter needed? If yes, a utility representative should visit the site and provide further guidance
  - Determine if future-proofing is of interest (see pages 10-13). If yes, take the following steps:
    - Mention this in conversations with the utility
    - Confirm with the electrical contractor the number of stations you might look to add in the future. Have them prepare to run wiring during the initial installation
  - Contact the Permitting Office



☑ Conduct on-site evaluation with electrical contractor

- Identify power source: The site host will need to ensure that ownership or written approval for the power source is obtained
  - Power proximity
    - The distance between the power source and the desired station location will affect installation costs. The further the station is from the power source, the higher the site-work and material costs (for trenching, boring, etc.)
    - Running power from the power source can be done either above ground with conduit (especially with wall-mounted stations) or below ground. The mounting type, location and proximity to the power source will inform this decision. Often, running through conduit is less expensive than burying underground
- Finalize charging station selection

  Contractor should ensure the following regarding the charging station:

  - Meets UL requitements and is listed by UL or another testing laboratory
  - Has appropriate weatherization for site needs with appropriate NEMA-rated enclosure
  - Has cord length that could satisfy reach and access to vehicle charging inlets without excessive slack
  - Is offered in the proper mounting type based on site guidelines and characteristics

☑ Complete installation and inspection

The following steps will likely be performed by the electrical contractor for installation:

- Confirm that permit from City of Raleigh is complete and approved
- Begin excavation
  - Removal of any material for running the conduit, wiring and/or the charging station
- Run conduit from power source to station location
- Complete rough inspection
- Pull wires
- Prepare and mount charging stations

Case Studies

What can we learn from others who offer public or commercial charging?

North Carolina State University

Overview

North Carolina State University (NCSU) has a reputation for outstanding commitment to technological innovation and sustainability. This commitment extends beyond the university's curriculum and is reflected in the EV charging infrastructure across the school's Raleigh campus. NCSU's charging program began with two stations (with four total ports) in 2010, funded by a Congestion Mitigation and Air Quality (CMAQ) grant. After installing the stations, NCSU recognized the benefits of expanding the program, with increased user demand and a growing number of EVs in Raleigh. NCSU now owns and manages eight charging stations (16 ports).

Why EVSE?

Growing interest in EV charging from employees, students and other community members motivated NCSU to initially begin its charging station deployment. The stations are also a community benefit and align with the NCSU Transportation Department's sustainability goals to reduce fossil fuel usage and carbon footprints throughout campus.

"We've discovered it is far more difficult to retrofit parking areas than it is to put a charging station in a parking deck where we had anticipated that there might be charging infrastructure there. It is cheaper and easier to do that! I really wish we had thought about this a long time ago with our parking decks."

-Darcy Downs, Transportation Planner,
NC State Transportation

NCSU chose Level 2 chargers because, at the time, fast chargers were still very new, and NCSU wanted to ensure that the charging station types were consistent across campus. Staying with Level 2 chargers also keeps the charging time maximums and parking enforcement rules the same for all stations.

Info on Chargers and Installation

- Type of chargers: ChargePoint Level 2 Dual Port Charging Stations
- Charging Network: ChargePoint
- Type of Mount: Pedestal and Wall Mount
- 8 stations, 16 charging ports owned and operated by NCSU
  - 5 charging stations on Centennial Campus
  - 1 charging station near NCSU Veterinary Medicine school
- Locations of chargers were determined by projected user demand, proximity to academic buildings and locations of existing stations

Procurement

- First stations were funded by a CMAQ grant in 2010, with ongoing maintenance paid for by NCSU Transportation Department, and further grant funding.

Charging Rates

- NCSU has no fee to use its charging stations. All stations are available to the public and accessible from public access points. Charging

station users, however, need an NCSU parking permit to park in the charging spaces. NCSU created three permit options available to purchase through its Transportation Department:

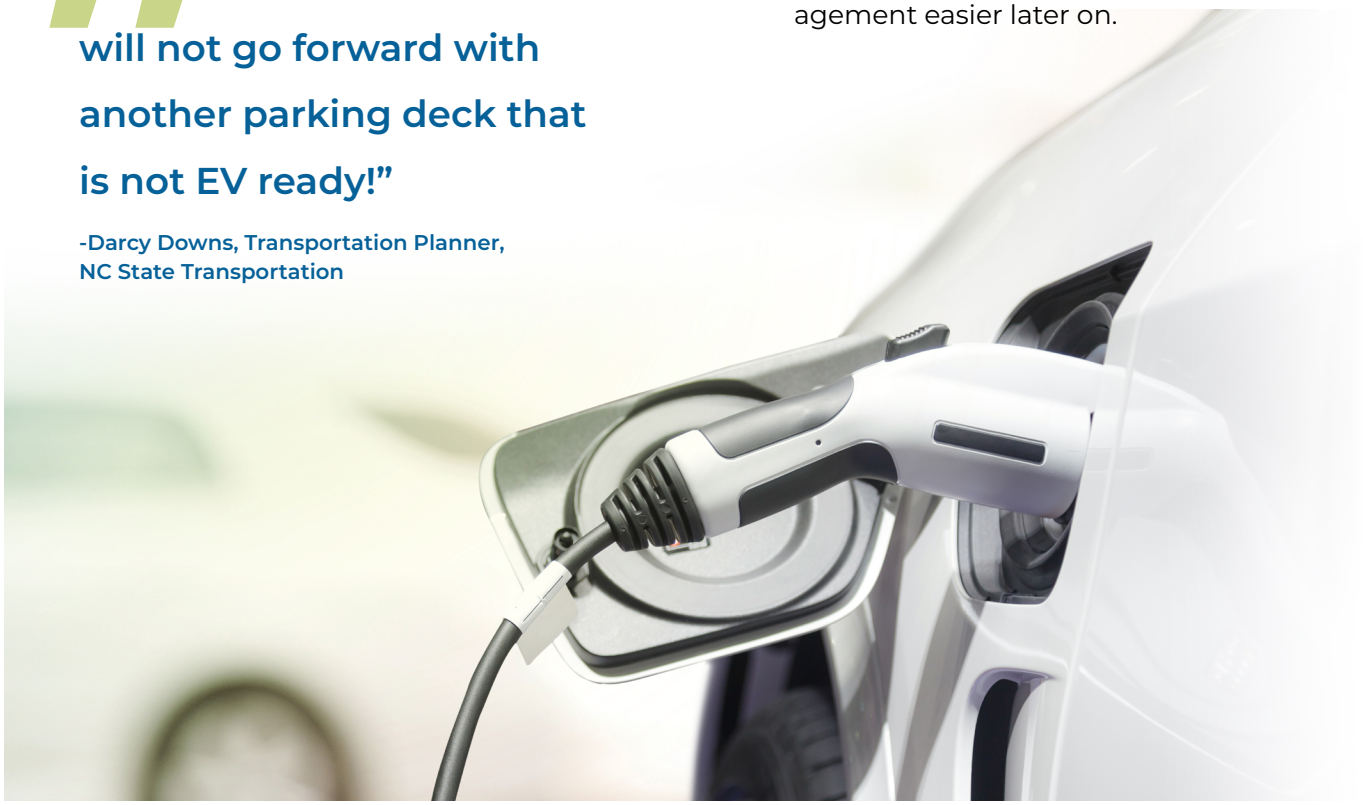
- NC State Affiliated (student, employee, faculty): $1.00/hour
- No permit/visitor to NCSU's campus (open to general public): $2.50/hour
- EV Permit (available to purchase for community members): $10/month or $100/year for unlimited charging

All of NCSU's charging stations require a ChargePoint card or mobile app (in addition to a valid NCSU parking permit) for access. Regardless of permit, all users have a maximum of 4 hours to charge in the designated EV charging spots, enforced by NCSU's Transportation Department.

> **"We will make sure that we will not go forward with another parking deck that is not EV ready!"**
>
> **-Darcy Downs, Transportation Planner, NC State Transportation**

What NCSU Learned

- It is often easier and cheaper to incorporate the capacity for charging stations into new or developing construction than into retrofits of existing spaces in parking lots or decks. This includes allocating the physical space for conduit, ensuring there is internet/cellular connection for user apps and identifying nearby electricity connections.
- For parking spaces that are nearby work or school locations, like those at NCSU, 4-hour maximum use times can balance convenience with charging efficiency. Four hours is roughly half of a traditional workday and allows early users to charge in the morning while freeing up the spaces for others in the afternoon.
- Understanding who manages and pays for the electricity is important to consider when looking at potential charging station locations, especially on larger sites. Confirming who pays, whether it is a specific site, building or the larger organization, makes management easier later on.



Wake Technical Community College

Overview

Wake Technical Community College (Wake Tech) is committed to promoting a culture of sustainability across its campuses and throughout the community. Its EV charging station infrastructure is just one aspect of this commitment, and it's continually growing. Wake Tech installed its first four charging ports in 2012 after receiving a Duke Energy grant. Those stations were monitored and managed by Duke Energy for the first couple of years. User demand for the stations has continued to increase since then, prompting Wake Tech to grow its charging station program and include installations within capital improvement projects. Across existing and new construction plans, Wake Tech is scheduled to have over 30 charging ports by early 2023 and seeks to add 24 charging ports at its new Eastern Wake 4.0 site.

Why EVSE?

Wake Tech initially installed charging stations to advance sustainability efforts on campus and provide a community-wide benefit for EV drivers. The success of the charging stations and growing use among students, faculty and other community members confirmed that initial motivation over time. In addition to providing a community benefit, Wake Tech makes the charging stations visible to passing drivers and locates them in priority areas close to facilities. Placing charging in prime locations is intended to reward EV drivers for doing their part to promote sustainable travel on and near Wake Tech campuses. With the current trends in the automotive business and the promise by many automobile makers of having entirely electric fleets by 2035, it is more important than ever to increase the number of EVSE on campus to be prepared for this change.

Info on Chargers and Installation

- Types of Chargers: Level 2 chargers, combination of single and dual ports
- Charging Network: ChargePoint, Bosch, JuiceBox
- Type of Mounts: Pedestal Mount
- 30 charging ports on campus or in planned construction:
  - 10 ports on Southern Wake Campus
  - 4 ports on Scott Northern Wake Campus
  - 12 ports on RTP Campus
  - 4 ports on Perry Health Sciences Campus
- Locations of ADA-accessible EV spots are based on a variety of factors, such as user demand, proximity to ADA pathways and proximity to campus buildings and facilities. The timing of installing new charging stations is determined by available and procured grants and coordination with the capital improvement plan.

Procurement

Wake Tech's first stations were purchased using a Duke Energy grant. Other stations were funded by Wake Tech's Foundation, other donors or internal funds, and a Volkswagen Settlement grant allocated by the North Carolina Department of Environmental Quality.

Charging Rates

There is no fee to use the charging stations regardless of user type (i.e., student, employee or community member).

What Wake Tech Learned

- The accessibility of charging stations is important to consider. Wake Tech prefers to place charging stations near access points on the site or in a parking garage. Signage for accessible parking and accessible charging priority are also useful.
- Sites should consider use times for vehicle charging to increase utilization of the stations and allow more users to charge. Wake Tech's Level 2 chargers let users charge for 2- to 4-hour periods, allowing them to park their cars and return to move them after classes or during breaks throughout the day.
- The visibility of charging stations is beneficial. Wake Tech uses a combination of signage and asphalt labeling/striping. It is also important to ensure that signage for charging is clearly marked for accessible priority if applicable. Make sure that all signage is consistent across all campus parking spaces. Developing signage guidelines early in the process is recommended. Pro Tip: If applicable to the site, ask the painter for the decal used to mark "EV" on the parking space asphalt/concrete so that future EV spaces use the same painting design or so that it can be re-painted later.
- Promoting and getting the word out about vehicle charging is important! Mention it on the organization's website and mark charging locations on a digital map so users know where to find them. Wake Tech created online maps that show where EV chargers are located on each campus.

> **"Range anxiety can occur in consumers that go to purchase electric vehicles. If we can help to reduce that anxiety and show that we have spaces, it's telling them, 'we've got you covered, you'll make it back home after class.'"**
>
> **-John Majernik, Director**
> **Energy, Sustainability, and Transportation**
> **Wake Technical Community College**

- Consider working with the engineer and site design team to install a solar shade or other canopy around the charging station unit. This extends the life of the charger, creates a more attractive parking location, prevents fading of information and can further demonstrate clean energy technologies.
- Consider what types of charging cords best fit your needs before installing. For example, depending on the type of parking space, make sure your cable is long enough to reach around a car if the charging port is on the opposite side of the vehicle. You might prefer retractable cables because they have a cleaner presentation and prevent people from driving over them.

Caraleigh Mills Condominium Development

Overview

Caraleigh Mills is a condominium development located off Maywood Avenue near the State Farmers Market. The property was originally a textile mill built in stages starting in 1892. It was converted to 84 condominium units in 2003. It is included on the National Registry of Historic Properties.

Caraleigh Mills is distinguished from many other condominiums: It sits on 16 acres that provide abundant green space; it boasts industrial architecture with tall ceilings and windows, old floors and interior as well as exterior brick walls; and it has amenities including a pool, gym, community building and garden, playground and now EV charging stations.

Why EVSE?

From an environmental perspective, the EV charging stations contrast with the coal-fired plant that powered the mill in its textile-production days. Residents and visitors are reminded of that earlier period by the very tall, now inoperative, smoke stack in the center of the property. Caraleigh Mills' current commitment to environmental stewardship is demonstrated by its composting service, community garden, non-smoking regulation for all interior spaces and EV charging stations.

In a resident survey, 50% of respondents indicated interest in EV charging. The rationale for installing EVSE was to offer the convenience to residents. Caraleigh Mills recognized the transition to EVs was accelerating, and residents were interested in the lower total vehicle costs and savings from transitioning from gasoline fuel to electricity. It also recognized that charging stations would be needed to keep up with other condominiums and improve its standing in the real estate market.

Prior to installation, no residents owned EVs, citing a lack of charging as a primary reason. Similar to many multi-family developments, parking spaces are not located close to a facility with accessible electrical outlets that would allow a driver to charge from an authorized parking location.

Info on Chargers and Installation

- 2 JuiceBox Pro 48 commercial chargers
- Dual charger pedestal
- Level 2 rated at 11.5 kW
- 25-foot cords
- Wi-Fi connectivity
- Sized panel to allow for the expansion of up to eight charging stations in the future

Procurement

Total project cost was $14,905 for hardware, software, electrical upgrades, site modifications and installation.

Charging Rates

Users pay $0.13 per kWh. The homeowners association covers all other costs.

What Caraleigh Mills Learned

- Technical expertise to evaluate software options was challenging until a knowledgeable resource was brought in to assist. Involving that resource earlier would have made the project much easier.
- Integrating the EVSE software, credit card processing, internet connectivity and homeowners association management software was challenging.
- The project was separated into phases, beginning with installing the electrical upgrades, then selecting the charging equipment and finally agreeing on costs to users and other procedures. Thinking of the project in these phases made it more manageable.
- There are many resources available to consult with, including the electric utility, who can help with the decision-making process.
- It will be important to encourage users to move their cars once fully charged. As usage increases, users will need to develop norms of cooperation and/or there may need to be more formal signage, rules and/or policies in place to allow all participating residents access to charging.

"This was essentially a 'build it and they will come' project. None of the unit owners owned an EV at the time the go-ahead decision was made. Currently, five unit owners have purchased EVs, and we anticipate more.

Convincing the HOA Board to spend $15,000 on a future-oriented, good-for-the-community project was an achievement."

-Mike Hanley, Caraleigh Mills Resident

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