RESIDENTIAL CHARGING STATION INSTALLATION HANDBOOK
for Single- and Multi-Family Homeowners and Renters
Version 1.0
You understand and agree that the installation and inspection of electrical charging stations for electric vehicles is an extremely complex and dangerous activity.

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RESIDENTIAL CHARGING STATION INSTALLATION HANDBOOK
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Version 1.0

This handbook was made possible through the support of Duke Energy, Progress Energy, the North Carolina Electric Membership Corporation and Dominion Virginia Power, as well as municipalities such as the City of Raleigh who supplied information and shared best practices regarding charging station installation.
Our day-to-day means of transportation is changing, and the more communities and consumers know about Plug-in Electric Vehicles (PEVs), the more prepared they will be to embrace them. This handbook has been developed to assist you in assessing your options for vehicle charging at your home or residence and provide you with information to take the next step toward owning or leasing a PEV.

For more than 10 years, Advanced Energy’s Electric Transportation team has been collaborating with stakeholders across the United States on PEV technologies and initiatives. We share our expertise with you to simplify the integration of electric transportation into your community.

To learn more, please visit www.advancedenergy.org and www.NCPEVTaskforce.org.
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Benefits of PEVs

There are many benefits to driving PEVs. Drivers are able to get where they want to go in high performance vehicles using fuel that is cheaper, cleaner and “made” in America. Additional benefits include:

+ **LOWER COST**
PEVs have lower fuel and maintenance costs, which are expected to eventually outweigh upfront vehicle costs, allowing for more affordable transportation. Additionally, electricity rates are fairly stable and the existing power grid has capacity to handle charging – especially during off-peak times. PEVs even have better overall fuels and run at a $0.50 - $1 per gallon equivalent to gasoline.

<table>
<thead>
<tr>
<th>US Average $ / kWh</th>
<th>Average Miles / kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>10¢</td>
<td>3.5</td>
</tr>
</tbody>
</table>

+ **ENERGY SECURITY**
No matter how you look at it, the United States is currently dependent on foreign oil, with more than 60% of its petroleum being imported. Nearly two-thirds of this petroleum is used for transportation, and 76% of that is consumed by typical passenger vehicles (AFDC, 2011). Since PEVs utilize a fuel source local to the U.S., replacing typical passenger vehicles with PEVs provides the U.S. with an opportunity to make a significant decrease in foreign petroleum use, which translates to greater energy security.

+ **FEWER EMISSIONS**
PEVs are a much cleaner vehicle choice. PEVs have significantly lower emissions than conventional vehicles, and all electric vehicles actually have zero mobile source (tailpipe) emissions. Lower emissions translate to improved air quality, which contributes to improving the environment.

+ **BETTER PERFORMANCE**
PEVs are designed to operate at a high level of performance, and the electric drive motor will meet the expectations of American drivers with improved acceleration and handling characteristics.
WHY DRIVE ELECTRIC?

What’s Stopping Widespread Adoption?

Despite the benefits mentioned, there are several obstacles to total, widespread adoption, ranging from initial cost of ownership to readily-available charging infrastructure. While the current initial cost to purchase a PEV can be expensive, battery technologies continue to evolve and smaller batteries with extended ranges will eventually lower upfront costs. Federal tax incentives may help ease the cost difference between a PEV and a traditional gasoline vehicle. Monetary and non-monetary incentives will most likely be available, from federal tax credits based on battery size to incentives for conversions of fleet vehicles for businesses.

Incentives are important as they encourage consumers to adopt new products and ideas. These incentives can take many forms such as tax rebates, utility rebates, preferred parking spaces and access to high-occupancy vehicle lanes. Additionally, some utilities offer special charging station electrical rates to PEV users. While these incentives seem small, they can push a potential customer into a purchasing customer. Additional localized incentives not only influence purchase decisions, they also show automobile manufacturers that the local government is committed to supporting the adoption of PEVs.

However, as PEVs become less expensive to own and operate, some consumers may still hesitate to purchase all-electric passenger vehicles because of the perceived lack of charging infrastructure and “range anxiety” – fear of driving an electric car and becoming stranded without sufficient locations available for recharging. Through education and awareness, this potential roadblock can be overcome. And as consumer acceptance grows, the demand will be greater for charging stations along highways, at retail outlets and in parking lots/decks. As a result, “range confidence” will increase for potential consumers and owners.

Is driving electric right for you?

First, take a look at your actual driving patterns and determine how much driving range you really need. This will help you determine if a PEV is right for you.

The majority of commuters drive about 40 miles a day. All-electric vehicles usually have a range of about 70 to 100 miles before re-charging is required. A plug-in hybrid electric vehicle (PHEV) or an extended-range electric vehicle (EREV) will typically have an electric range of 10 to 40 miles, and an overall driving range of 300-400 miles.

Most new electric vehicles can plug into any standard 120-volt household outlet. If you have an all-electric vehicle or want the option of faster charging at home, you may want to install a 240-volt charging station in your garage or driveway.

For most electric car owners, a total re-charge will not be necessary for daily driving. But, increasingly, charging opportunities will be provided at work or while you shop – so you can ‘top-off’ your battery whenever you stop.
VEHICLE TYPES

Any vehicle using electricity as either its primary fuel, or in collaboration with a conventional engine to help improve its efficiency, can be referred to as an electric drive vehicle. With any evolving technology, there are variations. As such, electric drive vehicles can generally be classified into two categories, Hybrid Electric Vehicles and Plug-In Electric Vehicles.

Hybrid Electric Vehicles (HEVs)

A highway-capable vehicle utilizing liquid fuels (such as gasoline) to generate energy, but incorporating an energy storage system (such as a battery) to capture excess electricity and energy from external sources, which in turn increases the overall efficiency of the vehicle (reducing fuel consumption and emissions). This type of vehicle cannot be plugged into an electricity source in order to charge the battery. Instead, it charges the battery by using a combination of regenerative breaking and power from the internal combustion engine (ICE). HEVs can be classified as either mild hybrids or full hybrids.

+ **MILD HYBRIDS** have an electric motor that allows the engine to be turned off when the vehicle is coasting, breaking or idling, and assists the engine when extra power is needed, but cannot propel the vehicle on its own in electric-only mode.

+ **FULL HYBRIDS** have the ability to power the vehicle using only the engine, only the electric motor, or a combination of both. The Toyota Prius is an example of a full hybrid.
PLUG-IN ELECTRIC VEHICLES 101

PLUG-IN Electric Vehicles (PEVs)

A vehicle that plugs into the electric power grid to receive energy for propulsion. With the federal government’s national goal of one million PEVs on the road in the United States by 2015, these commercial and consumer vehicles will become increasingly more available in the next few years. PEVs include:

**PLUG-IN HYBRID ELECTRIC VEHICLES (PHEVs)**
- Similar to hybrid electric vehicles
- Includes additional energy storage capacity that recharges from the electric power grid
- Additional energy storage capacity allows the vehicle to drive using only electricity for 10 to 60 miles (depending on the vehicle’s battery size)
- Can be Parallel or Series

**PARALLEL PHEVs**
- Uses both ICE and/or an electric motor for propulsion
- ICE can also act as a generator to recharge the batteries
- Batteries can also be recharged through regenerative braking or by accessing the electrical grid
- Have an essentially unlimited range due to the presence of the ICE

**SERIES PHEVs**

**ALSO KNOWN AS EXTENDED RANGE ELECTRIC VEHICLES (EREVs):**
- Uses an electric motor for propulsion
- Also utilizes an ICE to run a generator that recharges the vehicle’s batteries
- Batteries can also be recharged through regenerative braking or by accessing the electrical grid
- Have an essentially unlimited range due to the presence of ICE

**ALL-ELECTRIC VEHICLES (EVs):**
- Any vehicle driven solely by an electric motor

**NEIGHBORHOOD ELECTRIC VEHICLES (NEVs):**
- Includes any four-wheeled all-electric vehicle that is limited to a top speed of 25 miles per hour (mph)
- Typically lightweight
- Utilizes a small electric motor and battery pack
- Obtains a typical range of 20 to 50 miles; most states only allow NEVs on roads with speed limits of 35 to 45 mph or less
- Typically less expensive to produce than highway-capable vehicles
- Most commonly used as fleet vehicles for maintenance, security, etc. They are also often used at universities, retirement communities, or other large campuses/facilities

The key difference between Series and Parallel hybrids is that Series hybrids ONLY use an electric motor to drive the wheels.
CHARGING STATIONS

Charging stations are the point of power for electric vehicles, ranging in style and charging levels and are subject to standards and codes. It is important to note that while electric vehicle supply equipment (EVSEs) are most commonly referred to as charging stations, they are not battery chargers. The main purpose of a charging station is to establish communication with the vehicle and to transfer power to the PEV while providing proper grounding, shock protection, overload protection and general safety.

CHARGING LEVELS

There are several levels of charging, offering a range in charge time and infrastructure simplicity:

<table>
<thead>
<tr>
<th>Charging Level</th>
<th>Voltage &amp; Current</th>
<th>Charging Time (Average)*</th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Level 1</td>
<td>120 VAC, 16 amps</td>
<td>8-10 hours for a full charge</td>
<td>Manufacturer-provided cord set</td>
</tr>
<tr>
<td>AC Level 2</td>
<td>208 to 240 VAC, up to 80 amps</td>
<td>2-3 hours for a full charge</td>
<td>Equipment Needed**</td>
</tr>
<tr>
<td>DC Fast Charge (aka DC Level 2 by SAE definition)</td>
<td>200-500 VDC 200 amps</td>
<td>20 minutes for an 80% charge</td>
<td>SAE Combo Connector, Japanese CHAdeMO Connector**</td>
</tr>
</tbody>
</table>

*Estimated charge times are based on a vehicle utilizing 40 miles of electric-only driving between charges.

**Tesla has its own version of DC Fast Charge and AC Level 2.

Because Level 1 charging does not require the installation of specific charging equipment and the equipment is supplied with the vehicle, it is widely regarded as the simplest and most easily accessible charging method for drivers. However, for EV drivers, due to the lengthy charge time, most charging stations are expected to be Level 2. AC Level 1 is appropriate for PHEVs with smaller batteries such as the plug-in Prius.

Because of its high-speed charging capability, the DC Fast Chargers will primarily be commercial-grade charging, with potential applications at highway rest stops, fueling stations, fleet bases and car dealers.
CHARGING 101

Codes and Standards

In order to ensure common standards for vehicle charging, the Society of Automotive Engineers (SAE) has developed standards for energy transfer and a common cord. These standards will ensure all charging stations and PEVs have a common charging plug and receptacle, meaning any charging station will be able to plug into any PEV. The two main standards are SAE J1772 and SAE J2293, which reference other SAE, Underwriters Laboratories (UL) and National Electrical Code (NEC) standards or codes. The purpose of the two main SAE standards is to minimize costs and maximize simplicity for PEV owners.

SAE J2293-1 and J2293-2 are considered “umbrella documents” by reference of other SAE documents related to electric vehicles. Their scope includes the process of the charging stations establishing communication with the PEV, exchanging data and allowing the charging stations to transfer electricity through the cord set to the PEV.

<table>
<thead>
<tr>
<th>SAE Standard</th>
<th>Description</th>
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<tr>
<td>J1772</td>
<td>Electrical and mechanical aspects of the cord set; references UL for safety and shock protection as well as the NEC for the cord and coupler</td>
</tr>
<tr>
<td>J2293</td>
<td>Standard for the electric vehicle energy transfer system. This system encompasses what goes from the charging station to the car.</td>
</tr>
<tr>
<td>J2293-1</td>
<td>Functionality requirements and system architecture</td>
</tr>
<tr>
<td>J2293-2</td>
<td>Communication requirements and network architecture</td>
</tr>
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AC Level 2 Equipment Styles

Types of charging stations will differ based on site-specific requirements. The differences between models are primarily related to durability, weatherization, data logging functionality, remote communications capability and payment systems. Most charging stations in residential locations are likely to be Level 2. Currently, there are three primary mounting styles for charging stations:

**FLOOR-MOUNT (BOLLARD-STYLE)**
- Unit is mounted to the ground and wired through the base
- Typically requires concrete work
- Typically have largest footprint

**WALL/POLE-MOUNT**
- Unit is mounted to a wall or pole, as applicable
- Able to be mounted to and wired through garage wall
- Flexible placement options
- Takes up less space than floor-mount

**CEILING-MOUNT**
- Mounted to and wired through ceiling
- Minimizes trip hazard and vehicle impact risk
- Physical space must exist and not be obstructed by overhead garage door
- May require space on wall to store the J1772 plug

**NOTE** Floor-style units are the least desirable for garage installations and should typically be avoided in such scenarios. Wall/pole-mount stations and ceiling-mount stations will typically work well provided that sufficient space exists for mounting.
While workplace and public charging stations are necessary for PEV owners to overcome concerns about where and when they may be able to charge, residential (or home) charging is likely to make up the majority of charging scenarios for PEV owners. Additionally, overnight charging may allow you to take advantage of off-peak electrical rates, if they are offered by your utility provider.

*Early data from the EVProject indicates 96 percent of recorded charging events occurred at residential charging locations and 97 percent of electricity consumed for vehicle charging was from residential charging locations1.

As a PEV driver, you likely will charge your vehicle overnight at home using Level 1 or Level 2 charging. Depending on the average distance you travel each day, choose an appropriate charging level for your needs. Charging at home provides you with the stability and security of reliable and accessible charging.

The type of residence you call home may influence your ability to install on-site vehicle charging equipment. Some residence types pose unique challenges for a PEV owner, such as shared parking scenarios or a third-party approval process, which may be addressed by considering alternative charging scenarios. This document covers considerations for charging station installations at single-family and multi-unit dwellings.

### Single Family

A single-family home is a building occupied by just one household or family, and consists of just one dwelling unit or suite. Most single family homes are free-standing and do not share property with any other house or dwelling.

### Multi-Unit Dwellings

Multi-unit dwellings (also known as multi-family residences) are a classification of residential housing where multiple housing units are contained within one building or several buildings within a complex. Some multi-unit residences are owned as condominiums, where one or more units are owned individually rather than leased from a single building owner. Some common types of multi-unit dwellings are duplexes, townhomes and apartments, mobile homes and manufactured-home parks. All are similar to single-family housing in terms of time-of-day charging and general power requirements, but installation requirements may be more similar to commercial parking lots and decks.
While the majority of housing units in the United States are single-unit, multi-family housing makes up nearly one third of the market and often occurs in higher densities in major metropolitan areas. As electric vehicles become more affordable and available, addressing the home charging needs of all residence types is essential.

For PEV owners who reside in multi-unit residences, such as townhomes, condominiums or apartment complexes, having a dedicated charging station may prove challenging.

Some of the common challenges faced by multi-unit residents are:

1. Shared or Public Parking
2. Limited/Restricted Utility Access
3. Complex Metering Systems
4. Third-Party Ownership and/or Approvals

Of 1,000 multi-unit residents surveyed across U.S. metropolitan areas:

- 55 percent indicated they had no assigned parking;
- 75 percent had no safe access to an electrical outlet while parking; and
- 30 percent indicated their residence was governed by a Home Owners Association².

² Survey conducted by Advanced Energy and Knowledge Networks using the web-enabled KnowledgePanel®, a probability-based panel designed to be representative of the U.S. population (January, 2012).
If you do not currently have a dedicated parking space at your residence, it may be challenging to ensure regular access to electrical vehicle charging. Some suggestions for addressing this issue include:

### Charging at your residence

**Purchase or assignment of dedicated parking through your building or property owner**
- Work with your property manager or HOA to determine if parking assignments are available for purchase or rental.
- If your own or lease a parking space that is not suitable for vehicle charging, you may be able to exchange your existing space with one more appropriate.

**Temporary, metered or guest parking**
- If your residence has temporary or guest parking, speak with your property manager or HOA about offering time-limited parking in these spaces to accommodate vehicle charging.

**Valet parking or charging services**
- Property managers may want to offer tenant amenities such as valet charging to maximize utilization of community charging equipment.

### Charging at alternate location

**Workplace/daytime charging**
- Many employers are preparing for PEV adoption by their employees by providing charging capability and ‘reserved’ parking for PEVs.
- If you park your car at work for up to eight hours or more, workplace charging may be all you need to keep your vehicle sufficiently charged. This may be as simple as plugging into an AC L1 outlet.
- Check with your employer to see if they will provide workplace charging opportunities and encourage them to plan for and participate in a PEV readiness program.

**Purchase or rental of charge-ready parking**
- Urban parking lot managers are beginning to offer additional amenities, including electric vehicle charging, to parking lot tenants for both long-term (daily or monthly) and short-term (hourly) rentals.

In September 2011, Ace Parking Management, Inc. (one of North America’s largest privately-owned parking management companies) installed three Level 2 charging stations in downtown San Diego, CA and led the parking lot management industry in installations of electric vehicle charging stations.3

- Charging can occur during work hours or at night in a lot near your residence.
- Low commitment for vehicle owner (no installation or maintenance, service provided by parking lot owner/manager).
- Offers flexibility in charging habits (for example, if you also have workplace charging and/or access to other public charging options).

**DC Fast Charging**
- Can recharge vehicle batteries (from 20 percent up to 80 percent) in less than 20 minutes.
- While not appropriate in most residential settings, property managers may offer DC fast-charging through a valet parking service as a perk to attract or retain tenants.
- DC fast-charging, where available, can provide charging opportunities for extending travel or accommodating destination charging.

Coordinate with your building manager or property owner to determine which parking and charging scenarios make the most sense for your transportation needs, budget, and parking situation.

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Once you’ve decided on Level 1 or Level 2 charging, you’ll need to consider the electrical requirements for each.

**AC Level 1:**
Level 1 charging utilizes a standard 120 volt alternating current (VAC) outlet and a 16 amp (A) dedicated circuit. It does not require special charging equipment beyond a Level 1 cord that will typically be provided by your PEV manufacturer.

**Electrical considerations for Level 1 charging:**
- Do you have an available 120VAC, 16A dedicated circuit in your parking area?
- If you do not have an appropriate circuit in place, can one be added? This should be an easy job for a qualified electrician if you have available capacity in your electrical panel.
- If your parking area is not enclosed (in a garage, for example), you will need to charge your PEV at an exterior-rated outlet. *Note: Advanced Energy has seen some cases where the charge cord plug size will not allow the exterior outlet cover to close properly. Take care when sizing the exterior outlet enclosure to ensure the charge cord plug will fit and allow the cover to close as required.*
- Basic recommendation for AC Level 1 is a 3-prong outlet with GFCI outlet on a dedicated 20A circuit.

**AC Level 2:**
Level 2 charging requires 208/240VAC power and typically a 40A dedicated circuit. It also requires a Level 2 electric vehicle charging station, primarily for safety reasons. The charging station serves as a safe conduit for providing the higher voltage power. Level 2 stations come with varying capabilities that influence their purchase cost. Simpler stations (aka “dumb stations”) can cost around $500. More complex stations (aka “smart stations”) with capabilities allowing you to view your charging status from the web or set delayed charging times will cost more. Installation cost for Level 2 charging stations can also vary widely, depending on the availability of electrical capacity at your charging location.

In some cases, an upgrade to the existing electrical service (i.e., the amount of power available to your home) may be required for the addition of a vehicle charging load. Contact your utility provider early in the process to determine your building’s electrical capacity. If an electrical service upgrade is needed, installation costs can be significant. Your electric utility and a qualified electrician can work together to provide installation cost estimates, if needed.

**Electrical considerations for Level 2 charging:**
- Level 2 charging typically requires a 208/240VAC, 40A dedicated* electrical circuit, similar to what is required for a clothes dryer or oven.
- Most homes are not likely to have an available 208/240V, 40A circuit. If this is the case, one will need to be installed.
- Coordinate with your local electrical utility and a qualified contractor for installation requirements and cost estimate.
- If your parking area is not enclosed, make sure to select a charging station rated for outdoor use. Many Level 2 charging stations are rated for outdoor use, so it should not be a problem finding one. It is recommended that the AC Level 2 charging station is approved by a Nationally Recognized Testing Lab (NRTL), such as UL or TUG. A list of NRTL approved units can be found at GoElectricDrive.com.

**Note:** It is important to identify the owner of the power supply and develop an agreement that allows for the power supply to be used. If the customer is not the parking and power supply owner, it will be important to gain approval from applicable groups, such as home owner associations, prior to any installation work.

*Newer vehicles with faster on-board charging capabilities may use circuits up to 100A.
The question of who pays for the electricity required for recharging your PEV and how it is paid can be very complex. At a single-family home the answer is fairly straightforward, but what if you live in a townhome, apartment complex or condominium? Multi-unit dwellings such as these introduce many complexities.

**MULTI-UNIT CHALLENGE #3: COMPLEX METERING**

There are several common methods of metering electricity in multi-unit dwellings:

- **Residential Metering:** Each tenant’s electricity is metered by a dedicated electrical meter. Often the meters are grouped together in one location to make meter reading easier for the electric utility. Residential metering may make it easier to navigate the complexities of charging station installations at multi-unit dwellings; however, this is not always the case. It may not be cost feasible to route the electricity supplying your charging station through your dedicated electric meter.

- **Master or Group Metering:** A single meter that measures electricity usage for an entire building or area without distinguishing amongst the included areas/units. In this metering scenario, it will be difficult to determine the electrical consumption for a single tenant’s charging station.

- **Common Area Metering:** A meter that measures the electricity usage in common areas such as parking lots, laundry rooms, pool areas, etc. It may be more cost feasible to connect a charging station to a common area meter, but as with master or group metering, it will be difficult to determine the electrical consumption for a single tenant’s charging station.

With any of these metering cases, it is very important to consult with both your building or property owner and your electric utility to determine the best metering option for your charging station. In some instances, residential electrical loads can be sub-metered to capture usage and facilitate proper allocation of charges and billing; however, sub-metering in this manner is not always permitted.
If your residence is governed by a Property Manager or Home Owners Association (HOA), get them involved before you purchase a vehicle! Come prepared to discuss the benefits of PEVs and how they can benefit the community and environment. Also, check your state’s laws and civil codes for information about installing charging stations. For example, California Senate Bill 880, which went into effect in January 2012, restricts a home owners association’s ability to prohibit the installation of charging stations. However, this does not mean that associations cannot control or regulate installations.4

Preparing a multifamily residence for PEV charging requires involvement of the property managers, owners (apartment) or approval committee (townhouse or condo) when deciding which changes can and cannot be made to the property. A good first step is for all parties involved to discuss the extent of PEV charging to be approved at the site, and contact your local electric utility to request assistance in reviewing the requirements for PEV charge stations5. Some questions to consider are provided by Drive Clean California6:

- Will individual residents be permitted to charge PEVs in their current parking spaces, or will a decision be made to enable more centralized charging (near building electrical and metering equipment) for more residents?
- Will the building property manager, owner or HOA decide on a certain number of PEV charging locations, or respond to individual resident requests one at a time?
- Who will pay for PEV charging equipment, electrical system upgrades, electricity used and any additional property insurance or equipment maintenance required?
- Who will own the equipment? Could the resident take it with them when they move? If so, who will pay for restoring the property back to its original condition?

Additionally, the Bay Area Climate Collaborative has suggested several implementation actions to help get property managers, owners, and homeowner associations and other tenants involved in multi-family dwelling installations.7 Some of these include:

- Survey current residents and owners to determine how many already have a PEV or are likely to purchase one in the next 12 months.
- Determine if multiple dwellers are likely to want to charge at the same time, requiring one charging station per resident, or if charging station equipment can be shared among multiple drivers.
- Evaluate existing capacity of residential, group, and common area power supplies. Can your existing electrical service (i.e., the amount of power available) accommodate charging station loads without an upgrade?
- Evaluate existing policies regarding property use, including codes, covenants, and restrictions (CC&Rs) and architectural or design requirements. Are there existing policies regarding cost recovery for electrical service upgrades, charging station installation work, and/or ongoing electricity costs and service?
- Decide in advance who pays what. Which costs are paid by the residents and which by the HOA or property owners collectively?
- Determine what technology is needed for measuring costs and collecting revenue (if necessary)?
- Establish policies for the ongoing operation. For example, who owns the equipment? What happens when the driver moves? Is any special insurance coverage required? Who is responsible for repairs?
- Develop necessary documentation (i.e., engineered drawings if required), solicit construction quotes and obtain all necessary internal and local jurisdictions approvals (i.e., HOAs, property owners, city building department).

To:
Name of Applicant ________________________________________________________________________________________
Address _______________________________________________________________________________________________
City: _________________________________________________________ State: ________ Zip: __________________
Telephone: (daytime) _____________________________________ (evening) _____________________________________

Proposed Improvement:
Applicant must complete the following and submit with application:

- Detailed written description of improvement,
- Site plan showing size, shape and location of improvement and distances to residence and adjoining properties,
- Architectural plans/drawings (for major additions/improvements),
- Grading plan, if applicable.

Example Drawings

Applicant hereby warrants that Applicant shall assume full responsibility for:

(i) Obtaining all required City, Town or County approvals relating to said improvements.
(ii) Complying with all applicable City, Town or County ordinances.

Signature of Applicant: ______________________________________________________ Date: ____________________
Residential Charging Station Installation Handbook for Single- and Multi-Family Homeowners and Renters

BENEFITS TO PROPERTY OWNERS/MANAGERS

As vehicles arrive in your area, tenants and residents will start to expect opportunities to charge up and go. Offering vehicle charging opportunities at your facilities will not only benefit your current and future tenants, but can also result in significant property value adds:

+ **Market Differentiation**
  - Offering high-end amenities such as vehicle charging can distinguish your property from others to attract a more diverse tenant base.
  - Alternative fueling opportunities enhance green initiatives and highlight your commitment to social responsibility.

Apartment developers like Equity Residential are installing car charging stations to increase the number of residents that can participate in the EV revolution. Equity Residential has apartment locations in 13 states and currently offers charging at locations at four locations across the U.S.\(^8\)

+ **Tenant Resident retention**
  - An estimated 40 million PEVs are expected to be on the road by 2030.\(^9\) In just the next few years, virtually every major auto manufacturer will release an electric vehicle model. The Nissan Leaf, Chevy Volt, Ford Focus and C-Max, Mitsubishi i-MiEV, and Tesla are already on the road in most markets. As such, home vehicle charging will become a priority for residents when deciding when deciding on a place to live.
  - Of 1,000 multi-family housing tenants surveyed across U.S. metropolitan areas, 24 percent indicated that they would give preference to properties with electric vehicle charging stations and 17 percent indicated that they would pay more for a residence that provides electric vehicle charging.\(^10\)

Surprising statistics as less than one percent of those surveyed owned an electric vehicle at the time (Jan 2012).

\(^10\) Survey conducted by Advanced Energy and Knowledge Networks using the web-enabled KnowledgePanel\(^\circledR\), a probability-based panel designed to be representative of the U.S. population (January, 2012).
+ **Business Development**

- Having your charging station listed in local and national charging station locators (databases) may drive EV owners to your location.

+ **Revenue Opportunities**

- While consumer willingness-to-pay studies are yet incomplete, there are several business case scenarios that may apply to rental or managed properties for revenue generation, ongoing operating expenses, or investment cost-recovery.

+ **Parking Fees**

- Tenants with dedicated parking or regular access to community parking with vehicle charging capability, could be assessed an additional parking fee on a monthly, quarterly or annual basis.

+ **Per-session Charging Fees**

- Per-session charging fees can be assessed as a per-use parking fee or as an additional service fee. Per-use fees typically reflect what a driver might expect to pay if charging a vehicle at home using a residential utility rate. (Example: With an average residential electric rate of $0.10 per kWh and a battery capacity of 20 kWh, a driver could expect to pay $2.00 per full charge.)

+ **Advertising**

- Where charging stations are installed in high traffic or prominent community areas, opportunities for corporate sponsorship and/or targeted advertising could reduce investment costs or provide additional revenue streams.

In May 2012, the Portland Oregon DoubleTree parking facility announced installation of smart EV charging stations which feature high-resolution touch screens designed to deliver superior quality interactive advertising and messaging. The charging stations operate under a long-term advertising agreement between Double Tree and EV charging station technology vendor, OpConnect. Double Tree and OpConnect will receive revenue generated as a result of advertising displayed on the charging stations, in addition to usage revenue from EV drivers.¹¹

Emerging EV-charging service providers, such as Car Charging Group and U-Go Stations, are providing turn-key EV charging station installation, maintenance and support at no cost to property owners. This model enables parking facilities, apartment complexes, malls and retail outlets, as well as corporate and industrial parks, to quickly provide additional value to their customers, tenants and employees.

“Residents at Lexington Park, one of the most desirable apartment communities in Tampa, Florida’s prestigious west side, have gained the convenience of charging their EVs where they live. “We pride ourselves on providing our residents and customers with best-in-class amenities at our properties,” said Tania Currier, Lexington Park’s Property Manager. “A growing number of our residents are now driving EVs and we want to provide the convenience of refueling while at home. Residents at our Lexington Park community in Tampa are very pleased that they can now easily fill up where they live. This is a shareable amenity for all of our tenants.” Car Charging Group installed Level II, 240 volt electric vehicle charging stations at no cost to the property owner. Car Charging Group retains ownership of the charging technology and performs all installation, maintenance and servicing of the equipment.”

Businesses interested in setting up EV-charging services for their tenants should fully understand any legal, regulatory and/or other relevant requirements involved in the process prior to providing this service.

When considering installation of a charging station, planning is vital. Taking the time up front to gather specific information will allow for time and cost savings over the course of the installation.

The following information provides a general overview of the installation process, and is broken down into three steps:

**STEP 1: ASSESS CHARGING OPTIONS**

**STEP 2: EVALUATE EQUIPMENT**

**STEP 3: PREPARE FOR INSTALL**
RESIDENTIAL INSTALLATION: PROCESS OVERVIEW

**STEP 1: ACCESS OPTIONS**

- **Purchasing a PEV?**
  - no: Evaluate alternate charging scenarios
  - yes: Assigned parking?
    - no: Accessible electrical outlet?
      - no: Can an electrical outlet be installed?
        - no: Evaluate alternate charging scenarios
        - yes: Can a space be reserved?
          - no: Evaluate alternate charging scenarios
          - yes: Accessible electrical outlet?
            - no: Can an electrical outlet be installed?
              - no: Evaluate alternate charging scenarios
              - yes: 120V

**STEP 2: SELECT EQUIPMENT**

- **120V**
  - Use 120V cord set per manufacturers recommendations

- **240V**
  - Install “plug in” Level 2 equipment per manufacturers recommendations

**STEP 3: PREPARE FOR INSTALL**

- Contact electrical contractor for installation options
STEP 1: ASSESSING YOUR CHARGING OPTIONS

The first step in assessing your charging options will be to determine your current or planned parking scenario. The intended use, such as time of day or nighttime charging, should also be considered when determining a vehicle-parking and charging location. Parking scenarios may vary greatly, from private garages, carports, and driveways to on-street parking, apartment lots, condominium lots, and decks.

Each parking scenario has unique features and issues to be addressed when considering vehicle charging. For example, outdoor parking will require weather-resistant equipment and unrestricted spaces will need to address public safety.

Typical residential parking scenarios can be characterized as:

- Residential Garage
- Residential Carport/Driveway
- Parking Decks and spaces
- Parking Lots and Spaces
- On-Street Parking and Spaces
PARKING LOCATIONS

Residential Garage
- Simple, most basic installation
- AC Level 1 or Level 2 charging
- Time-of-day charging typically occurs early evening/overnight
- Limits exposure to the elements
- Prevents unwanted access

Carport/Driveway
- Increased exposure to the elements
- External cords present increased potential for trip hazards
- Requires greater ability to withstand weather and physical damage

Parking Decks
- Vehicle owner may have limited ownership of resources
- Parking spaces may be reserved for specific persons
- HOA or other organization typically involved and must approve installations
- Limited ability to utilize an existing meter or panel

Parking Lots
- Similar to single-family housing in terms of time-of-day charging and general power requirements
- More difficulty in ability to reserve a space and utilize a circuit that can be directly tied to the vehicle owner, more often leading to the need for a new meter and/or communications
- Will likely need to involve the homeowners association (HOA)/property management.

On-Street Parking
- Parking location does not usually belong to the homeowner
- No means of ensuring necessary space will be available when needed
- Presence of sidewalk presents increased potential for trip hazards; possible reason for inspection failure from permitting entity
- Potential solutions of installing a curb-cut or a driveway require approval/permits from local municipality or permitting entity
Consider available space on floor, walls and ceiling.

- Ensure overhead doors do not conflict, along with other objects.
- Ensure installation does not conflict with vehicle ability to park in garage.

Note the location of the charging port on the expected vehicle.

Note whether the driver typically backs into the garage or pulls in head-first.

Compile steps two and three to determine where the charging port is likely to be when parked in a garage.

- Eliminate locations in a garage requiring a cord to be wrapped around or draped over the vehicle in order to reach the charging port.
CARPORT/DRIVEWAY

1. Consider available parking areas.
   - If a particular charging station has been selected, eliminate surfaces to which it cannot mount.

2. Note the location of the charging port on the expected vehicle.
   - If no vehicle has been selected, most vehicles are expected to have a charging port toward the front end of the vehicle.

3. Note whether the driver typically backs into the driveway or pulls in head first.

4. Compile steps two and three to determine where the charging port is likely to be when parked in a driveway or carport.
   - Eliminate locations that require a cord to be wrapped around or draped over the vehicle in order to reach the charging port.
Select appropriate parking spaces based on the following criteria:

1. **Visibility**
   - Locations more visible to drivers and pedestrians are less likely to be vandalized.

2. **Proximity to Power Source**
   - Typically an electrical closet or vault, this translates to shorter run length and fewer barriers to avoid or bore through, saving cost.

3. **Length of Parking Spaces**
   - If there is a difference in length of parking spaces in a parking deck, longer spaces will allow for greater room to fit a charging station while maintaining usability and limiting the risk of vehicle impact.
   - It is important that the installation of a charging station does not shorten parking spaces to below minimum local zoning requirements.

4. **Width of Parking Spaces**
   - Wider parking spaces decrease the risk of a cord set being damaged if it lies to the side of PEV, connected or otherwise.

5. **Lighting**
   - A well-lit parking space translates to a lower risk of tripping and damage to the charging station from vehicle impact or vandalism.

6. **Weather**
   - If possible, placement of charging station toward the interior of a parking deck can improve the life of a charging station.

**Survey the charging station at the particular parking space(s)**

**Consider Available Space on Floor, Walls and Ceiling.**

- If a charging station has been selected, only consider appropriate mounting surfaces.
Select appropriate parking spaces based on the following criteria:

**VISIBILITY**
- Locations more visible to drivers and pedestrians are less likely to be vandalized.

**PROXIMITY TO POWER SOURCE**
- Selecting spaces close to an existing transformer or panel with sufficient electrical capacity will save cost.

**AVOIDANCE OF EXISTING INFRASTRUCTURE AND LANDSCAPING**
- Installing charging stations close to existing infrastructure or trees can cause damage which may result in higher costs, potential hazards and other undesirable outcomes.

**LENGTH OF PARKING SPACES**
- If there is a difference in length of parking spaces in a parking deck, longer parking spaces will allow for greater room to fit a charging station while maintaining usability and limiting the risk of vehicle impact. It is important the installation of a charging station does not shorten parking spaces to below minimum local zoning requirements.

**WIDTH OF PARKING SPACES**
- Wider parking spaces decrease the risk of a cord set being damaged if it lies to the side of PEV, connected or otherwise, and provide space for proper operation of the charging station. Additionally, wider spaces will make it more accessible for the driver to reach the charging port if the port is located on the side of the vehicle.

**LIGHTING**
- A well-lit parking space may reduce the risk of tripping and damage to the charging station from vehicle impact or vandalism. Additionally, it may aid in the operation of the charging station, including plugging the vehicle in.

Survey the charging station at the particular parking space(s)

**CONSIDER AVAILABLE SPACE ON FLOOR, WALLS AND CEILING.**
- If a charging station mounting type has been selected, eliminate types of location that do not match (i.e.: ceiling-mount units may not work on walls).
- Ensure installation does not conflict with driver’s ability to park within the space and to adequately use the charging station and plug in the vehicle.

**PARKING LOTS CAN BE ASSUMED TO USE HEAD-IN PARKING FOR CONSISTENCY.**
Select appropriate parking spaces based on the following criteria:

1. **VISIBILITY**
   - Installations along streets with high foot and vehicle traffic, especially at night, are less likely to be vandalized.

2. **PROXIMITY TO POWER SOURCE**
   - Selecting spaces close to an existing transformer or panel with sufficient electrical capacity will save cost.

3. **AVOIDANCE OF EXISTING INFRASTRUCTURE AND LANDSCAPING**
   - Installing charging stations and conduit close to existing infrastructure or trees can cause damage which may result in higher costs and potential hazards.

4. **LIGHTING**
   - A well-lit parking space may reduce the risk of tripping and damage to the charging station from vehicle impact or vandalism.

5. **ADA ACCESSIBILITY**
   - At the time of publishing, there were no official ADA requirements for vehicle charging (see recommendation for ADA at the end of this handbook).

Survey the charging station at the particular parking space(s).

1. **CONSIDER AVAILABLE MOUNTING SPACES**
   - Most on-street charging stations will be either floor-mount or pole-mount units.

2. **FOR PULL-IN SPACES, CHARGING STATIONS SHOULD BE PLACED IN FRONT OF THE SPACE AND EITHER CENTERED ON THE SPACE OR PLACED BETWEEN TWO SPACES.**
   - Centered stations can serve one vehicle while stations placed between spaces can serve two vehicles. Charging stations with two connectors should be placed between spaces. Charging stations with more than two connectors should not be used in on-street locations.

3. **FOR PARALLEL PARKING LOCATIONS, THE CHARGING STATION SHOULD BE INSTALLED AT THE FRONT THIRD OF A PARKED VEHICLE, BASED ON THE DIRECTION OF TRAFFIC FLOW.**
   - Charging stations with single connectors are typically recommended due to the lower potential trip hazard versus a
STEP 2: EQUIPMENT SELECTION

Charging stations are the source of power for PEVs and range in style, charging speed, cost and installation complexity. In order to ensure proper technology selection and charging station placement, it is important to understand the intended use of the charging station(s).

Calculate Your Minimum Miles/Hours of Charging Rate:

In order to calculate your minimum miles/hours of charging rate, complete the following:

1) Estimated miles traveled per day (consider weekend travel and daily commutes):
2) Estimated number of consecutive hours parked at charging location:
3) Divide Line #1 by Line #2:

The number calculated on Line #3 is the minimum “miles/hour of charging” rate necessary to meet your daily transportation needs for driving an all-electric vehicle.

Example: On any given day, you may need to leave work a little early to pick-up your children from school, go to the doctor and then swing by the grocery store or pharmacy.

Commute to work 20 miles each way 40 miles
Pick-up children from school +5 miles
Go to the doctor +5 miles
Grocery store or pharmacy +5 miles
TOTAL 55 miles

If you drive 55 miles and charge your car at night for 10 hours, your minimal charge rate would be 5.5 miles/hour.

Of course, your daily travel distance will vary; however, this provides a general idea of charging needs.

Now, locate your vehicle type in the table below (Column A) and select an appropriate charging Level for your estimated travel needs (Column D or E).

<table>
<thead>
<tr>
<th>Make/Model</th>
<th>Battery/Charger</th>
<th>Electric Mode Range (EPA rating)</th>
<th><strong>Level 1 – 120V/16A</strong> (Miles/Hour of charging)</th>
<th><strong>Level 2 – 240V/40A</strong> (Miles/Hour of charging)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plug-in Hybrid</strong> *</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chevy Volt</td>
<td>16 kWh / 3.3 kW</td>
<td>35</td>
<td>3-5 miles</td>
<td>10-14 miles</td>
</tr>
<tr>
<td>Toyota Prius</td>
<td>4.4 kWh / 3.5 kW</td>
<td>11</td>
<td>3-5 miles</td>
<td>11 mi. (max)</td>
</tr>
<tr>
<td><strong>All Electric</strong> **</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coda Auto. Coda</td>
<td>31 kWh / 6.6 kW</td>
<td>88</td>
<td>3-5 miles</td>
<td>20-25 miles</td>
</tr>
<tr>
<td>Ford Focus Electric</td>
<td>23 kWh / 6.6 kW</td>
<td>76</td>
<td>3-5 miles</td>
<td>20-25 miles</td>
</tr>
<tr>
<td>Honda Fit EV</td>
<td>20 kWh / 6.6 kW</td>
<td>82</td>
<td>3-5 miles</td>
<td>20-25 miles</td>
</tr>
<tr>
<td>Mitsubishi i-MiEV</td>
<td>16 kWh / 3.3 kW</td>
<td>62</td>
<td>3-5 miles</td>
<td>10-14 miles</td>
</tr>
<tr>
<td>Nissan Leaf</td>
<td>24 kWh / 3.3 kW</td>
<td>73</td>
<td>3-5 miles</td>
<td>10-14 miles</td>
</tr>
<tr>
<td>Tesla Model S</td>
<td>56 kWh / 9.6 kW</td>
<td>265</td>
<td>3-5 miles</td>
<td>40-45 miles</td>
</tr>
</tbody>
</table>
Level 1 charging requires no additional equipment installation for vehicle charging. A charging adapter is generally supplied by the vehicle manufacturer and comes with a user manual with operating instructions.

**Best practices for using the Level 1 charging adapter are:**

**Cord Safety:** Ensure sufficient space around electrical equipment for safe operation. Charging cords should be used and stored in such a way as to minimize the obstruction of typical walking paths. Mounting a wall peg or hook near the electrical power source may aid safe storage and cord management.

**Lighting:** A well-lit parking area can reduce tripping hazards and aid operation of the vehicle charging equipment (e.g. plugging into the vehicle port). Adequate lighting can also reduce risks of vandalism.

**Weatherization:** Weatherization should be considered when using any outdoor power source. Indoor and outdoor outlets vary in performance requirements and types of materials used. A watertight outside outlet cover allows the outlet to stay covered even when in use (e.g. with a cord plugged in). The National Electrical Code also requires the use of ground fault circuit interrupter (GFCI) outlets in outdoor settings. A GFCI outlet trips itself off when it senses a current leakage or a short circuit.

**Electrical Safety:** Follow the manufacturer’s operating instruction for use of all charging equipment. A dedicated AC 120 volt/16 amp electrical circuit and outlet are recommended for battery charging. If the circuit is shared, and another electrical device is being used at the same time the vehicle is being charged, the breaker may trip or other hazards may occur. Consult a professional electrician to evaluate your electrical system’s integrity and safety and/or to install a dedicated circuit if one is not already available.

**Cord Security:** Most Level 1 charging cords have a place at the bottom of the connector handle to insert a small lock (such as a luggage lock). Lock the handle while charging to prevent removal of the charging cord from your vehicle and safeguard your equipment from theft.
Level 2 charging offers a faster vehicle charging option than Level 1. For Level 2 charging, there are a variety of stations available that can suit your needs depending on your parking structure and situation.

The table below summarizes the most common charging station types by parking scenario.

<table>
<thead>
<tr>
<th>Parking / Mount Type</th>
<th>Wall-Mounted</th>
<th>Ceiling-Mounted</th>
<th>Pedestal-Mounted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garage</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Car Ports/Driveway</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Parking Lot</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Parking Deck</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>On-street</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Level 2 charging units come in both a modular model (removable units that plug into a standard 208/240 volt outlet) and a hard-wired model (units that are wired directly to your home’s electrical system). Modular models are easier to install as they can be plugged directly into a standard 208/240 volt outlet, which are typical of your larger home appliances, such as a refrigerator or dryer. It is recommended that you have your electrical wiring inspected for safety and integrity prior to adding additional loads to your home. In some situations, a service panel upgrade may also be required.
Best practices for using Level 2 charging stations are:

**Cord Safety:** Ensure sufficient space around electrical equipment for safe operation. Charging cords should be used and stored in such a way as to minimize the obstruction of typical walking paths.

**Lighting:** A well-lit parking area can reduce tripping hazards and aid operation of the vehicle charging equipment (e.g., plugging into the vehicle port). Adequate lighting can also reduce risks of vandalism.

**Weatherization:** Weatherization should be considered when using any outdoor power source. The National Electrical Code also requires the use of ground fault circuit interrupter (GFCI) outlets in outdoor settings. A GFCI outlet trips itself off when it senses a current leakage or a short circuit.

**Electrical Safety:** Follow the manufacturer’s operating instruction for installation and use of all charging equipment. A dedicated AC 240 volt/40 amp electrical circuit and outlet are recommended for Level 2 charging. If the circuit is shared, and another electrical device is being used at the same time the vehicle is being charged, the breaker may trip or other hazards may occur. Consult a professional electrician to evaluate your electrical system’s integrity and safety and/or to install a dedicated circuit if one is not already available.

**Cord Security:** Most Level 2 charging cords have a place at the bottom of the connector handle to insert a small lock (such as a luggage lock). Lock the handle while charging to prevent removal of the charging cord from your vehicle and safeguard your equipment from theft.

**Circuit Re-Closure:** Some models of Level 2 charging stations do not automatically reset in the event of a power interruption or circuit trip. In these events, if your charging station does not have automatic circuit re-closure, the charging session will terminated and will NOT be automatically restored when the power supply returns to normal. Automatic circuit re-closure is important if you have an all-electric vehicle as your primary source of transportation, as early termination of a charging session may result in significant travel delays.
Ownership Options

Level 2 charging equipment is widely available from a number of suppliers, vendors, and manufacturers. Some car companies have partnerships with specific charging station vendors, which they recommend for their vehicles. In some cases, the cost of equipment and installation may be rolled into the price of the vehicle purchase. Most charging station manufacturers have installation services for their products, or offer their products for direct sale through local retailers. Additionally, equipment can be found at your local home improvement or electronics stores. Consumers have the choice of contracting the installation of equipment through the product manufacturer, local supplier, or by contacting a qualified electrical contractor. Visit the Licensed Electrical Contractors website (http://www.contractors-license.org/) to locate an authorized installer in your area.

Charging stations can be found from a variety of sources ranging from independent vendors to national retail outlets such as Best Buy, Home Depot and Lowes.

Additionally, as the market for electric vehicle charging equipment expands, the opportunity for alternative-ownership models grows. Some equipment manufacturers offer leasing options for equipment installation and rental. Also, emerging third-party service providers, such as Car Charging Group and U-Go Stations, are providing EV charging solutions that cover installation, maintenance, and on-going support services at no additional cost to property owners. These providers install and operate the charging station equipment and only collect fees for individual use of the equipment.

Some of the currently available purchasing options include:

<table>
<thead>
<tr>
<th>Retail Locations</th>
<th>Leasing Opportunities</th>
<th>Third-Party Service Providers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amazon</td>
<td>Pep Station</td>
<td>Car Charging Group</td>
</tr>
<tr>
<td>Best Buy</td>
<td></td>
<td>U-Go Stations</td>
</tr>
<tr>
<td>Home Depot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lowes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Some of the currently available purchasing options include:

Select an ownership option that works best for your specific charging needs and budget. In situations where your parking facility is owned by another party (e.g., building owner), it is important to decide in advance who will pay for the charging station equipment and installation. There are many pay-per-use features and equipment models that can help support cost-recovery of installation, operation and equipment charges. Additionally, non-permanent installations (i.e., modular plug-mounted Level 2) can be easily removed and relocated when your residence or parking scenario changes. Discuss options with your parking facility manager and select a scenario that best fits your individual parking situation.

Hard Wired vs. Modular Unit: Some wall mount Level 2 units can either be hard-wired for a more permanent installation or plug-mounted for simple removal. Choose the option that works best for you.

Level 2 charging station purchase and installation costs can vary considerably. Factors affecting cost are the number of charging stations, the features and functionality of the selected equipment, and the complexity of the installation. As a rule of thumb, costs tend to increase with increasing distance from the parking location to the available power source. Residential charging stations can cost up to $1,200 for basic installation excluding the cost of the charger. Consult a licensed electrical contractor for a cost estimate.

Discounts and incentives can also lower the cost of installation. State, city or utility incentives may be available for any given installation project. To find a list of current incentives, search the AFDC’s Federal and State Incentive and Laws database (www.afdc.energy.gov/afdc/laws).14

COST TO CHARGE YOUR PEV

Charging your battery is much cheaper than fueling a gasoline car. For example, if you were to drive the U.S.-average of 40 miles or less per day (nearly 15,000 per year) at an average electricity cost of $0.10 a kWh, your typical daily charging cost would be $1.15, or approximately $34 per month. Comparing that to a gasoline car with 30 miles per gallon (mpg) paying $3.50 per gallon of gas, the typical daily fuel cost would be $4.65, or approximately $140 per month. Also, all new PEVs offer a timer that allows you to set the charge time for off-peak hours to ensure that you pay the cheapest rate for electricity if they are available in your area.

Expected monthly fuel costs (assuming 40 miles traveled per day):

<table>
<thead>
<tr>
<th>Gasoline Car</th>
<th>Price per Gallon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miles per gallon</td>
<td>$3.00</td>
</tr>
<tr>
<td>20</td>
<td>$180</td>
</tr>
<tr>
<td>25</td>
<td>$144</td>
</tr>
<tr>
<td>30</td>
<td>$120</td>
</tr>
<tr>
<td>35</td>
<td>$103</td>
</tr>
<tr>
<td>40</td>
<td>$90</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electric Car</th>
<th>Price per kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miles per kWh</td>
<td>$0.05</td>
</tr>
<tr>
<td>3</td>
<td>$20</td>
</tr>
<tr>
<td>3.5</td>
<td>$17</td>
</tr>
<tr>
<td>4</td>
<td>$15</td>
</tr>
</tbody>
</table>

Electric Utility Rate Plans for EVs:

Many electric utilities offer special off-peak charging rate discounts for PEVs and provide guidance on getting your home ready to charge. Typically you will have the option of moving toward a special time-of-use rate for your whole house that will include your PEV, or you can choose to install a second meter just for your PEV use. Some utilities are also considering incentives such as rebates to off-set the cost of installing a charger at your home. There are several utilities that have special PEV programs and tools for calculating vehicle operating costs. Be sure to contact your local utility to find out what they offer.
OTHER CONSIDERATIONS

Communications
Charging station owners will need to determine whether they desire remote communication to and from the charging station. This may be for gathering usage information, restricting use of the station or for billing options. If such communication is required, it will be important to select a site that is compatible with the station’s communication capabilities. This may be a wired communication line (e.g. Ethernet) in which proximity to existing CATV cable is advised, or may be wireless in which strength of signal will be important. Some manufacturers and trained installers will be able to evaluate the ability to communicate wirelessly at a site.

Payment Models
It is important to determine whether it will be necessary to bill for use of the charging station. If this is a requirement upon installation, or sometime in the future, it will be necessary to select a station that can handle billing or be upgraded to provide these billing features. Alternatively, site owners may wish to assign/sell special permits allowing vehicles to park at their charging stations. This could be a simple alternative to recoup the associated equipment and installation costs.

Circuit Reclosure
Some models of Level 2 charging stations do not automatically reset in the event of a power interruption or circuit trip. In these events, if your charging station does not have automatic circuit re-closure, the charging session will terminate and will NOT be automatically restored when the power supply returns to normal. Automatic circuit re-closure is important if you have an all-electric vehicle as your primary source of transportation, as early termination of a charging session may result in significant travel delays.
# EQUIPMENT SELECTION WORKSHEET

<table>
<thead>
<tr>
<th>Category</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Charging Level</strong></td>
<td>□ AC Level 1 &lt;br&gt; □ AC Level 2 &lt;br&gt; □ D/C Fast Charge</td>
</tr>
<tr>
<td><strong>Mounting Style</strong></td>
<td>□ Bollard or Pedestal &lt;br&gt; □ Ceiling &lt;br&gt; □ Pole &lt;br&gt; □ Wall</td>
</tr>
<tr>
<td><strong>Station Power</strong></td>
<td>□ Modular (Removable Plug) &lt;br&gt; □ Hardwired</td>
</tr>
<tr>
<td><strong>Access Controls</strong></td>
<td>□ No access restrictions &lt;br&gt; □ Access restrictions (e.g. RFID card, key code panel, etc.)</td>
</tr>
<tr>
<td><strong>Communications</strong></td>
<td>□ None &lt;br&gt; □ Monitoring/Reporting capability (e.g. report kWh usage) &lt;br&gt; □ Communications (e.g. email notifications) &lt;br&gt; □ Reservation system</td>
</tr>
<tr>
<td><strong>Payment Options</strong></td>
<td>□ No payment capability &lt;br&gt; □ Future upgrade potential &lt;br&gt; □ Card swipe payment &lt;br&gt; □ Subscription service</td>
</tr>
<tr>
<td><strong>Other Features</strong></td>
<td>□ Aesthetics (e.g. station color) &lt;br&gt; □ Cord type (e.g. coil or straight), retention device &lt;br&gt; □ Illumination (e.g. on station) &lt;br&gt; □ Circuit re-closure</td>
</tr>
</tbody>
</table>
STEP 3: INSTALLATION

Collect Site Information

Depending on the complexity of your parking scenario and your equipment needs, installation options may vary widely. Use the following Site Characterization Worksheet to document the structure type, electrical accessibility and metering complexity of your current parking location prior to speaking with your HOA, property manager/building owner and/or electrical contractor or certified charging station installer.

SITE CHARACTERIZATION WORKSHEET

Parking Type/Structure: ________________________________________________________________

Distance to power source (approximate): ________________________________________________

Metering Type (if known): ____________________________________________________________

Ownership of site where the charging stations will be installed: __________________________

Necessary approvals to install a charging station at the site*: _____________________________

*You should have authorization form available upon site visit or be willing to sign form claiming permission to install charging station(s) at the site.

A more detailed description of parking installation scenarios can be found at Advanced Energy Resources > Charging Station Installation Handbook. (http://www.advancedenergy.org/transportation/resources/)
USE OF EXISTING OUTLETS

1. Confirm electrical capacity and safety.
   - The electrical system requirements for your specific equipment will be listed in the manufacturer’s specification documents. If you are unsure of how to confirm the available electrical capacity and safety of your system, contact a certified electrical contractor for inspection prior to installation.

2. Contact your utility.
   - Customers should contact their local utility to inform them vehicle charging infrastructure will be installed at the site. The customer should ask their utility the following questions:
     - What is the size of the electrical service to the site? (The utility may be able to provide knowledge as to 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 can save me money on the cost of installation or going-forward electricity costs?
     - If there has been a determined need for a service upgrade or a new meter, an appointment should be made with a utility planner to visit the site. When possible, this should be coordinated with an electrical contractor. The customer may find it easier to allow the contractor to speak directly with the utility regarding the installation. If so, the customer will need to contact their utility and provide permission for the contractor to speak with the utility regarding the particular site.

3. Purchase outlet-compatible equipment (as needed).

4. Install equipment.
   - Equipment should be installed according to manufacturer’s specifications.

5. Charge vehicle.
Excavation

- Excavation includes any removal of material for the purpose of running conduit and/or wiring as well as being able to install a charging station.
- Typical actions include removal of drywall, insulation, pavers and concrete or pavement, as well as hand digging, trenching, boring and drilling.
- **NOTE** In areas where existing infrastructure is in place (determined from utility marking), hand excavation is generally advised versus mechanical excavation.

Run Conduit from power source to station location

- Conduit should be run in most locations. Residential garages may allow for the use of nonmetallic-sheathed cable and do not require conduit to be run.
- For charging stations rated more than 60 amperes, a separate disconnect is required (NEC 625.23) and should be installed when running conduit. Some customers may desire a separate disconnect for stations rated below 60 amperes as well. A separate disconnect should be visible from the charging station.
- **NOTE** Chapter 3 of the NEC addresses wiring methods and materials. Many options exist. Contractors are strongly advised to examine requirements for installation sites and types of wiring and conduit to be used.

**LESSON LEARNED** An interpretation of the NEC does not consider removable pavers to be sufficient in decreasing required depth of conduit.

Rough Inspection

- An initial electrical inspection should take place after conduit has been run and prior to connecting equipment and running wires.
- If the installation does not pass inspection, the contractor will need to correct any items discussed by the inspector and schedule a second rough inspection prior to moving on to the next step.
- **NOTE** For some installations, typically detached or semi-detached homes, this may be the only inspection required.

Pull Wires

- Charging stations require two hot lines, a neutral and a ground. Charging equipment is considered to be a continuous load.
- Conductors should be sized to support 125 percent of the rated equipment load (NEC 625.21).

Prepare mounting surface per charging station manufacturer instruction

- Floor-mount: typically requires a concrete foundation allowing conductors to enter through the base of the charging station and appropriate installation of J-bolts based on station base plate.
- Wall/Pole/Ceiling-mount: brackets may be installed to allow for the mounting of the charging equipment.

Mount Charging station(s)

- Ensure equipment is level and mounted in accordance with manufacturer instructions.
Service upgrades, new service or and/ or new meter is installed. The utility may also pull a meter in order to allow for the charging station wires to be connected to a panel.

Perform Finish Work
- Replacement of drywall
- Burial of conduit and conductors
- Filled and compacted as necessary
- Replacement of walking surfaces
  - Concrete
  - Asphalt
  - Pavers

**NOTE** If any existing infrastructure has been damaged during excavation or installation, repairs should be made prior to finish work.

Final Inspection
- If required, the inspector will examine wiring, connections, mounting and finish work, and ensure the charging station is safe for operation in its given location.
- Provide copy of inspection documents for their records.

Performance Verification
- If possible, the contractor should verify the charging station functions properly.
ELECTRICAL UPGRADES AND HARD-WIRE INSTALLATIONS

1. Contact your utility.
   - Consumers should contact their local utility to inform them vehicle charging infrastructure will be installed at the site. The customer should ask their utility the following questions:
     - What is the size of the electrical service to the site? (The utility may be able to provide knowledge as to 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 can save me money on the cost of installation or going-forward electricity costs?
     - If there has been a determined need for a service upgrade or a new meter, an appointment should be made with a utility planner to visit the site. When possible, this should be coordinated with an electrical contractor. The customer may find it easier to allow the contractor to speak directly with the utility regarding the installation. If so, the customer will need to contact their utility and provide permission for the contractor to speak with the utility regarding the particular site.

2. Consult Electrical Contractor or Equipment Installer.
   - The contractor will be responsible for meeting the applicable code requirement and obtaining the necessary permitting approvals. Specific tasks of the contractor may include:
     - Contacting the Local Permit Office
       - Different jurisdictions may have slightly different requirements or processes regarding the permitting, installation and inspection of charging stations. The contractor should contact the permitting office with jurisdiction over the installation site to identify specific requirements. Requirements of interest are listed below.
     - Concealment
       - While uncommon, certain municipalities may require charging stations to be concealed with a hedge, fence or other object. It important to make sure that the concealment does not interfere with the proper operation of the charge station. Requirements of interest are listed below.
     - Engineering Calculations
       - Municipalities may require load calculations to be performed and/or stamped by a licensed engineer. This can vary based on the location and number of charging stations to be installed.
       - If engineering calculations are required, the contractor should coordinate the assessment time with the visit of a utility planner (if deemed necessary), the initial contractor visit and the customer’s schedule. If these cannot be coordinated, each visit should be encouraged to happen as quickly as possible and all information should be reported to the contractor.

3. Purchase equipment (as needed).
4. Install equipment.
   - Equipment should be installed according to manufacturer's specifications.
5. Charge vehicle.
# INSTALLATION PROCESS CHECKLIST

<table>
<thead>
<tr>
<th>ACTION</th>
<th>PERSON RESPONSIBLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Decision made/approval obtained to install charging station</td>
<td>Residential Owner</td>
</tr>
<tr>
<td>Single-Family home (excludes street parking)</td>
<td>Residential Owner</td>
</tr>
<tr>
<td>Multi-Family Home</td>
<td>Property Owner/HOA</td>
</tr>
<tr>
<td>Individual Townhome/Condominium</td>
<td>Owner (must gain approval for installation from HOA/similar group)*</td>
</tr>
<tr>
<td>Apartment Complexes</td>
<td>Parking Owner</td>
</tr>
<tr>
<td>Workplace, Retail, Public Lots/Decks</td>
<td>Parking Owner</td>
</tr>
<tr>
<td>On-Street Parking, Residential Owner (obtaining permit and reserving parking space)</td>
<td>Residential Owner</td>
</tr>
<tr>
<td>On-Street Parking, Non-Residential</td>
<td>Right of Way Owner</td>
</tr>
<tr>
<td>2 Charging level and number of charging stations determined</td>
<td>Owner</td>
</tr>
<tr>
<td>3 Charging station(s) selected</td>
<td>Owner</td>
</tr>
<tr>
<td>4 Parking space(s) selected</td>
<td>Owner</td>
</tr>
<tr>
<td>5 Power source selected</td>
<td>Owner/Utility</td>
</tr>
<tr>
<td>6 Installation estimate made</td>
<td>Contractor</td>
</tr>
<tr>
<td>7 Site plan created; Need for electrical upgrade determined</td>
<td>Contractor/Utility</td>
</tr>
<tr>
<td>8 Estimate approved/accepted</td>
<td>Owner/Contractor</td>
</tr>
<tr>
<td>9 Permit application filed</td>
<td>Contractor</td>
</tr>
<tr>
<td>10 Electrical upgrade completed, if required</td>
<td>Utility</td>
</tr>
<tr>
<td>Panel upgrade/new panel</td>
<td>Contractor</td>
</tr>
<tr>
<td>Service upgrade/new service</td>
<td>Utility</td>
</tr>
<tr>
<td>New meter</td>
<td>Utility</td>
</tr>
<tr>
<td>11 Power restored</td>
<td>Utility</td>
</tr>
<tr>
<td>12 Installation</td>
<td>Contractor</td>
</tr>
<tr>
<td>13 Inspection</td>
<td>Inspector</td>
</tr>
<tr>
<td>14 Work completed/Performance verified (provide copy of inspection report to customer)</td>
<td>Contractor</td>
</tr>
</tbody>
</table>
Other areas of consideration regarding installation and operation of your vehicle charging system are:

- **Vandalism**: Stations are designed to be vandal resistant, but secure parking structures and increased visibility will likely deter vandals.

- **Signage**: Consider reserving parking spaces for electric vehicles only.

- **Maintenance**: Additional data is required to better understand maintenance costs and schedules. A maintenance solution is recommended to ensure station longevity, safety, and convenience. Be sure to inquire about all other anticipated costs associated with the selected charging station including short and long-term service contracts as these vary by manufacturer.

- **Safety**: Avoid placing stations in a major walking areas and consider cord management systems (e.g., retractable cable) to prevent tripping hazards and cord damage.

- **Liability**: Some multi-family residences and HOAs may require additional liability insurance to cover potential losses due to charging station installation and operation. Speak with your property manager or HOA to understand your full liability requirements.
Americans with Disabilities Act Standards

At the time of publication, Americans with Disabilities Act (ADA) standards specifically addressing the installation of charging stations in public parking areas (e.g., lots, decks, on-street, etc.) have not been established. However, ADA regulations apply to all government and commercial sites and charging station installation cannot violate the ADA compliance by making a site or a feature of the site non-compliant. Sites must be designed so that the facility (or part of the facility) is readily accessible to and usable by individuals with disabilities. In addition to national regulations, many states and cities have adopted individual and more restrictive regulations. It is recommended to check with your state and local government to see if any additional ADA regulations have been adopted.

The following are national standards and codes that guide ADA compliance:

- **2009 International Building Code — ANSI A117.1**
  
  This standard contains technical criteria to make sites, facilities, buildings and elements of the sites accessible to and usable by people with physical disabilities. The intent of this standard is to allow a person with a physical disability to independently get to, enter and use a site, facility, building or element of the site.

- **2010 ADA Standards — 28 CFR part 36**
  
  The 2010 ADA standards, published by the U.S. Department of Justice, sets minimum requirements for newly designed and constructed or altered state and local government facilities, public accommodations and commercial facilities to be readily accessible to and usable by individuals with disabilities.

In the absence of specific accessibility standards for electric vehicle charging stations, some states and municipalities have developed their own guidelines. Currently, there is some variation in how these regions have chosen to address accessibility standards. The recommendations in this Handbook are merely suggestions gathered from the most widely used approaches to achieving accessibility in charging station installations. The ultimate decision for inclusion of accessibility in the design of charging station installation is the responsibility of the property owner.

The following sections outline the areas of disabled-accessibility to be considered when installing a charging station.
Vehicle Parking Restrictions

The primary purpose of electric vehicle charging stalls is for the user to charge the electric vehicle’s battery and not for vehicular parking; therefore an accessibly-sized space should not be reserved exclusively for those with disabilities. Instead, it is recommended the accessibly-sized stalls be available for use by both disabled and non-disabled electric vehicle drivers. The accessibly-sized charging stalls should include signage marking the stall for electric vehicle drivers only. Federal regulations indicate that disabled drivers have the highest priority in parking and may park anywhere, without restriction, meaning that the following vehicles may use ADA-compliant charging station stalls:

- Disabled marked internal combustion vehicles;
- Disabled marked electric vehicles; and
- Non-disabled marked electric vehicles.

In order to reserve the charging station for the exclusive rights of a disabled driver, the station may be placed in a “marked accessible” parking space. This means the primary purpose of the stall would be for parking of disabled-marked vehicles, and charging would be the secondary purpose.

Number of Accessible Charging Stations

There are various methods currently being used for calculating the required number of disabled-accessible charging station stalls. The most prevalent method is to require one accessible charging station stall for every 25 charging station stalls. For van accessible stalls, one in every 10 accessible stalls should be van accessible.

<table>
<thead>
<tr>
<th>Charging Stations at Site</th>
<th>Accessible Stalls</th>
<th>Van Accessible Stalls</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2-25</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>26-50</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>51-75</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>76-100</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

Charging Station Placement and Design Criteria

For the placement of the charging station, there are some existing standards which apply, including:

- **Reach Ranges (ANSI A117.1 Section 308.2.1)**
  Indicates the controls should be designed so that where a forward reach is unobstructed, the high forward reach should be 48 inches maximum and the low forward reach should be 15 inches minimum above the floor.

- **Operable Parts (ANSI A117.1 Section 309)**
  Ensures all operable parts are in compliance with the code including, clear floor space, height and operation.

- **Automatic Teller Machines (ATMs) and Fare Machines (ANSI A117.1 Section 707)**
  Contains regulations such as operable parts and clear floor space. This section applies to charging stations and associated payment and fare machines.

Another consideration for accessibility in charging station placement includes the distance to the facility. Several of the existing ADA Charging Station guidelines have concluded the charging station itself is considered the facility of destination, thus it is not required for the charging station to be on the shortest accessible path to the nearest building. This means the path from the vehicle to the charging station must be ADA-compliant, but the path from the charging stall to the facility does not necessarily need to be the closest to the facility on the site. The State of California recommends the accessible charging stall should be located within 200 feet of the facility's main entrance for new construction (it does not provide a minimum guidance for existing facilities).
Accessible Charging Station Stall Dimensions

The dimensions for an accessible charging station stall should provide adequate room for the disabled user to maneuver around all sides of the vehicle. This is required because different electric vehicle models have different charging port locations (front, side, back).

- **Stall Dimensions**
  The dimensions for an accessibly sized stall should be 8x18 feet with an adjacent five-foot aisle for accessible vehicles, and an eight-foot accessible aisle for accessible vans. Additionally there should be enough room to allow for a 36-inch accessible path from the vehicle to the charging station. Some jurisdictions have indicated that they would prefer the van-accessible spaces to be 11 feet with a five-foot access aisle. This meets the overall width criteria, but allows for more room for the 36-inch path of travel.

- The 36-inch accessible route from the vehicles to the charging station and the adjacent access aisle must meet slope criteria as specified in the ANSI Standards (ANSI A117.1 - 403.3). Maximum of 1:20 running slope and 1:48 cross slope. Please refer to the regulations for guidance.
Obstruction

As mentioned, there should be room to allow for a 36-inch accessible route from the vehicle to the charging station. This means that special attention should be paid to any features which may obstruct this path of travel.

+ **Wheel Stops** Ensure that all wheel stops are placed so that the disabled user can travel from the vehicle to the charging station.

+ **Bollards or other protection for the charging station** Bollard installation for charging station protection should not obstruct ADA accessibility.

+ **Cord Management** Install the charging station so that the cord will not be located in the path of travel for the disabled user.

Access Aisle

There are many variations in the recommendations for access aisles with charging stations. These range from installing a striped accessible aisle from the accessible charging stall to the entrance of the site’s facility, to installing no access aisle at all. It appears the most common method used is the following: Accessible electric vehicle stalls should be located close to the building or facility entrance and should be connected to a barrier-free path of travel. It is not necessary to designate the path of travel as an accessible route as designated in ANSI 117.1.
The Regulation of Historic Homes

A historic property is an official building, structure, object, site or district worthy of preservation for its significance in American history, architecture, archaeology and culture. The National Register of Historic Places is a government agency that registers and lists the nation's historic properties. Its purpose is to ensure that properties significant in national, state and local history are considered in the planning of federal activities, and to encourage historic preservation at the state and local government level and within the private sector. The listing of a property in the National Register places no restrictions on what a private property owner using private resources can do to maintain or alter their property. Each state has a Historic Preservation Office and associated local historic preservation commissions that oversee historic preservation in the state and may have established local preservation laws that must be adhered to.

PEV Charging in Historic Homes and Areas in North Carolina

The North Carolina State Historic Preservation Office does not issue statewide laws or guidelines for historic areas. Local historic preservation commissions are responsible for the design review guidelines for historic landmarks or districts based on procedures and standards required by the enabling legislation.

At the writing of this report, no local commissions that were queried have guidelines or regulations specifically addressing PEV charging stations on historic properties. However, the expectation is that charging stations will be treated as any other “above-ground utility structure” installation, such as satellite dishes, HVAC equipment, electric panels, etc. A general guideline with such installations is that they should be installed so they are not visible from a public right-of-way or a surrounding yard. Often, they are located on a rear roof elevation or on the ground behind the building. Landscaping can also be used to conceal these structures.

Design review of a proposed charging station installation might be based on size, location and appearance of the charging station. Consideration would also be given to the installation of required power lines. Power for the station would need to be carefully routed for the protection of large trees and other landscaping on the property.

In addition to aesthetic considerations, a concern for PEV charging in historic properties is the available electrical capacity. Supplying a 40 amp circuit for a PEV charging station might pose challenges for some homes and buildings if they haven’t had an electrical service upgrade.

Overall, the queried local preservation commissions did not foresee charging station installation being a problem, but they acknowledged that each commission would have to review the installations on a case-by-case basis.

Resources

North Carolina State Historic Preservation Office
www.hpo.ncdcr.gov/default.htm

North Carolina Historic Preservation Commissions
A complete list of all historic preservation commissions in North Carolina
www.hpo.ncdcr.gov/commstaf.htm

Preservation North Carolina
A private non-profit membership organization that conducts preservation advocacy, education, and stewardship programs, as well as operates a fund for the sale of historic properties
www.presnc.org
CHARGING STATION
Device that transfers power to a PEV while providing proper grounding, shock protection, overload protection and general communication.

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE)
The official term for electric vehicle charging infrastructure; more commonly referred to as charging stations.

J1772 STANDARD
Defines a common charging plug for PEV charging stations.

MODULAR UNIT
A non-permanent, removable charging unit that can be plugged into an existing electrical outlet.

MOUNTING STYLE
Refers to placement/location of charging stations such as: Bollard (Floor), Wall, Ceiling or Pole mount.

NEC
National Electrical Code

NEMA
National Electrical Manufacturers Association

PEV
Plug-in Electric Vehicles

UL STANDARDS
Safety standards for charging electric vehicles developed by Underwriters Laboratories

UTILITY CONTRACTOR
Individual from utility that provides service upgrade, new service, new electric panel or new meter if/when needed.

UTILITY PLANNER
Verifies the need for a utility contractor to be brought in following the assessment of the electrical contractor. In any event, the electric utility should be notified of installations in order to ensure grid reliability.
There’s more to successfully implementing electric transportation than just installing charging stations. In fact, communities and municipalities should be wary of installing free or low-cost systems without proper planning.

As adoption and integration of PEVs becomes more mainstream, there is a need to review, analyze, test and evaluate available charging stations. Additionally, communities will need to have a clear understanding of each vendor’s offerings in order to determine the best solution for each site. Education and outreach efforts are integral components. From workshops, training and webinars to web-based tools and best practices guides, Advanced Energy continues to drive the future of electric transportation.

**Equipment Evaluation**

Advanced Energy’s interactive, web-based tool — Charging Station Technology Review for Plug-in Electric Vehicles — compares charging stations from various vendors across the United States. A result of an ongoing comprehensive review of technical information submitted by commercial vendors, service providers and other interested parties on electric vehicle supply equipment (EVSE), this online tool includes an overview of:

- Charging equipment and related systems/services
- Use of “smart charging” concepts
- Projected maintenance/repair schedules and costs
- Anticipated charging station billing models/systems

Learn more at http://www.advancedenergy.org/transportation/evse.
The electric transportation experts at Advanced Energy know handing a community a list of recommendations does not solve all of the challenges that must be overcome to move electric transportation forward; however, we help define ways to accomplish tasks smarter.

Advanced Energy, located in Raleigh, North Carolina, is a dynamic and growing nonprofit with a mission to provide economic, environmental and societal benefits through innovative and market-based approaches to energy issues. Founded in 1980, we focus on applied building sciences in residential, commercial and industrial settings; industrial process technologies; renewable energy; motors and drives testing; and emerging transportation initiatives (such as electric transportation). Our facility houses state-of-the-art laboratories where we perform testing and applied research in all of these evolving disciplines. We work collaboratively to demonstrate that industry, government and non-profits can successfully work together to improve the environment and encourage the economy.

Our Transportation Initiatives Division’s approach is to help all stakeholders and members of a community understand, plan-for and implement PEV Programs. Successful program implementation requires a comprehensive and replicable plan that addresses the key topics of policy development, barrier resolution, safety, consumer and work-force training, the design and delivery of outreach programs and the creation of local markets for PEVs. With an extensive network comprised of utility partners, charging station vendors and car manufacturers, we have a proven track record for success in consulting and planning, technical evaluation, and education and outreach, such as:

- Developing best practices and methodologies for integration and adoption of electric transportation.
- Contributing to numerous electric utility and U.S. Department of Energy (DOE) funded programs on PEVs
- Developing several guidance documents and tools on PEV infrastructure planning and implementation, including:
  - Charging Station Installation Handbook for Electrical Contractors
  - Community Planning Guide for PEVs
  - Comprehensive PEV planning matrix

Advanced Energy’s efforts have led to recognition by the Rocky Mountain Institute, the Clinton Climate Initiative and the International Energy Agency for accomplishments as one of the leading communities in the United States and the world for PEV readiness. One specific program we are particularly proud of is the North Carolina PEV Taskforce, which we established in 2011 in collaboration with the N.C. Department of Commerce to bring community stakeholders together in an effort to accelerate the adoption of PEVs and create green jobs in North Carolina. The Taskforce represents more than 200 organizations and nearly 400 active members.

To learn more about Advanced Energy or the PEV Taskforce, visit: www.AdvancedEnergy.org and www.NCPEVTaskforce.org
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