

# COMMUNITY PLANNING GUIDE FOR PLUG-IN ELECTRIC VEHICLES

VERSION 3.0



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Version 3.0

May 2013

This guide was made possible through the support of Duke Energy, the North Carolina Electric Membership Corporation and Dominion Virginia Power, as well as the City of Raleigh who supplied information and shared best practices regarding charging station installation.

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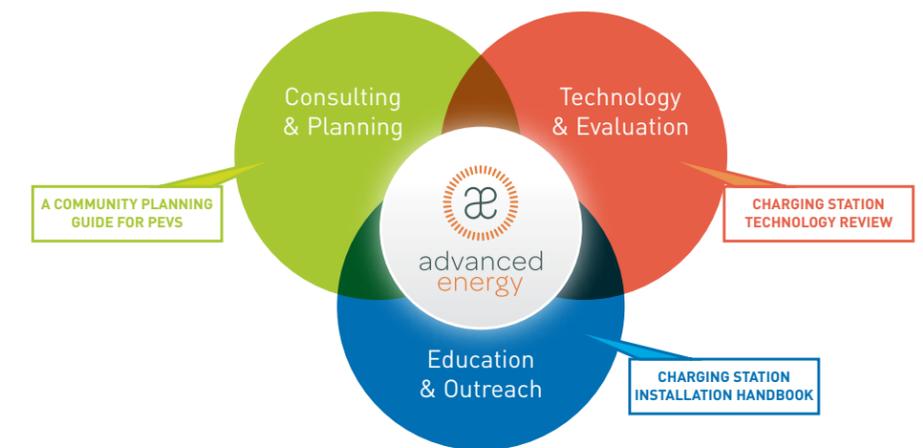
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## DRIVING THE FUTURE OF TRANSPORTATION

Advanced Energy's Electric Transportation sector is working to assist utilities, charging station vendors, municipalities and all initial stakeholders in understanding, planning for and implementing electric transportation initiatives. As your trusted resource for advancing electric transportation, we can assist you in creating a strong foundation for successful change through:

- ▲ Consulting and Planning
- ▲ Technical Evaluation
- ▲ Education and Outreach



The future of transportation is here! Our day-to-day means of transportation is changing, and the more municipalities, business leaders, utilities and end-users know about Plug-in Electric Vehicles (PEVs), the more prepared they will be to embrace the “vehicles of tomorrow” today. Consumers are already purchasing PEVs such as the Nissan Leaf and Chevrolet Volt. With their purchase, they will be expecting their homes, workplaces, communities and retail outlets to be equipped with the necessary electric vehicle supply equipment – better known as charging stations – and the supporting infrastructure to operate their vehicles.

This guide has been developed to help communities with all aspects of planning and preparing for the expected influx of PEVs, including best practices on installation, codes, standards, permitting and inspections, as well as information on municipal and utility involvement, and community outreach and education. For more than 10 years, Advanced Energy's Transportation Initiatives Team has been collaborating with stakeholders across the United States. We share our expertise with you to simplify the integration of electric transportation into your community.



# PLUG-IN ELECTRIC VEHICLES 101

## 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. 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 does not need to be plugged into an electricity source in order to charge the battery. Instead, it charges the battery by using a combination of regenerative braking 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.

Toyota Prius



# PLUG-IN ELECTRIC VEHICLES 101

## PLUG-IN Electric Vehicles (PEVs)

A vehicle that plugs into the electric power grid to receive energy for propulsion. 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



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

### + ALL-ELECTRIC VEHICLES:

- ▲ 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

Nissan LEAF



# BATTERY TECHNOLOGY

Although battery-powered vehicles have been an option for some time, their limited range has kept them from truly competing in the automobile market. While a lead-acid battery is typically used in an automobile with an ICE, their lack of energy density, short duration of power available and weight make them less than ideal for PEVs. Instead, a version of the lithium-ion batteries used in portable electronics has been identified as the most promising battery for vehicles. These rechargeable lithium-ion batteries, similar to the ones found in cell phones, digital cameras and laptops, have higher energy density and system energy efficiency, coupled with lower heat generation and lower long-term cost. Increased functionality of these batteries has advanced the performance of electric vehicles. And, as battery technologies continue to evolve, we expect battery functionality, life and overall cost to improve.

## Re-use & Recycling

The United States' demand for lithium has been steadily increasing, and will continue to do so with the number of lithium-ion batteries needed for PEVs. However, experts expect lithium's high level of recyclability will help with demand.

Batteries are expected to last approximately eight to ten years in vehicles. Once the battery is no longer able to hold the level of charge needed to adequately power the vehicle, owners should exchange the battery at a re-use/recycling center. Re-using is very important because even when a lithium-ion battery is no longer optimal for vehicles, it is still expected to retain 70 to 80 percent of its original charging capacity. These batteries can then be used for other applications requiring a lower level of performance, such as stationary power storage and load shaving. New options for the use of second-life PEV batteries are being explored by corporations with significant interest in the market. As the presence of lithium-ion batteries increases, so will the opportunities for their re-use.

Once the battery is no longer useful for primary and secondary applications, it will need to be properly discarded and recycled. This recycled lithium can offset our overall lithium needs.



## How Can Community Leaders Help?

After a PEV battery is no longer able to carry the level of charge needed to power their vehicle, owners need to be able to locate a re-use/recycling center to help them properly dispose of their battery. Community leaders and local governments can help keep the re-use and recycling rates high for PEV batteries by providing consumers with information about the re-use/recycling process for lithium-ion batteries, as well as the locations of re-use centers, recycling centers and battery exchange stations. Additionally, state governments may want to monitor recycling efforts to examine if regulations or incentives are needed to encourage consumers to recycle.

# WHY DRIVE ELECTRIC?

National security concerns, environmental impacts and rising fuel prices are some of the reasons driving the evolution of our nation's transportation sector. More and more automotive manufacturers are introducing electric vehicles into their product portfolios. In fact, every major automotive manufacturer and many that are lesser known have either launched or have plans to launch PEVs in the U.S. market by 2015. What has caused this push toward electric transportation?

## Quick Look

### PEVS OFFER:

- Better Performance
- Lower emissions
- Localized fuel source
- Lower fuel & maintenance costs

### OBSTACLES TO WIDESPREAD ADOPTION:

- Higher initial cost of ownership
- Readily-available charging infrastructure

## 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 - \$0.70 per gallon equivalent to gasoline.

### + 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 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 more than the initial cost of traditional gasoline vehicle, 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 also 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 make a difference. 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.



## Hot Spots

There are several cities across the U.S. that have been identified as PEV "Hot Spots" – cities vehicle manufacturers are targeting for initial release of their PEVs based on demographics and potential acceptance. Although vehicle manufacturers are identifying initial target rollout cities; they will make PEVs available to consumers in entire states. Considering the expanded availability, it is reasonable to expect wider regional adoption around rollout cities. As the influx of PEVs take place in these rollout cities, the surrounding municipalities and communities need to be prepared to learn early adoption lessons and plan.

Additionally, communities have a commitment to educate consumers, helping them to understand vehicle benefits and overcome concerns that hinder their use. It is vital for initial users to have a positive experience that will contribute to widespread acceptance. Measuring the impact of these new technologies on consumers, businesses, economic prosperity and the environment is a critical component to sustainability.



# CHARGING 101

With the rollout/adoption of PEVs there is a clear and present need for electric vehicle supply equipment (EVSE), most commonly referred to as charging stations. Charging stations are the point of power for electric vehicles, ranging in style and charging levels and subject to standards and codes. It is important to note that while EVSE are normally 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:

Charging Level	Voltage & Current	Charging Time (Average)*	Equipment
AC Level 1	120 VAC, 16 amps	8-10 hours for a full charge	Standard three-prong household outlet
AC Level 2	208 to 240 VAC, up to 80 amps	2-3 hours for a full charge	Will use only the SAE J1772 specified plug
DC Fast Charge	Approximately 480 VDC, 100 amps	30 minutes for an 80% charge	Under Development; Proposal to use Japanese CHAdeMO standard

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

Because Level 1 charging does not require the installation of specific charging equipment, it is widely regarded as the simplest and most easily accessible charging method for drivers. However, due to its lengthy charge time, most charging stations are expected to be Level 2.

Level 2 charging will be seen in both commercial and residential locations, with most residential Level 2 charging stations operating at a lower level of power. The initial cost for commercial equipment is estimated to be between \$1,500 to \$5,000 depending on manufacturer, model and features. Installation cost will vary based on several factors such as available power, pavement cutting and distance. Residential Level 2 charging stations will cost between \$300 to \$3,500 depending on manufacturer, model and features as well as intended location (garage, carport, driveway or dedicated parking spot). Location will impact pricing as outdoor units will need to be more rugged and weatherized.

## Typical Installation Costs for Level 2 Charging Stations:

- + **PUBLIC STATION**  
**\$4,000 to \$10,000**
- + **RESIDENTIAL STATION**  
**Can range from under \$100 for new construction to \$2,000 for older homes that may require extensive electrical upgrades and wiring.**

Because of their high-speed charging capabilities, DC Fast Charger charging stations will primarily be commercial-grade charging, with potential applications at highway rest stops, fueling stations, fleet bases and car dealers.

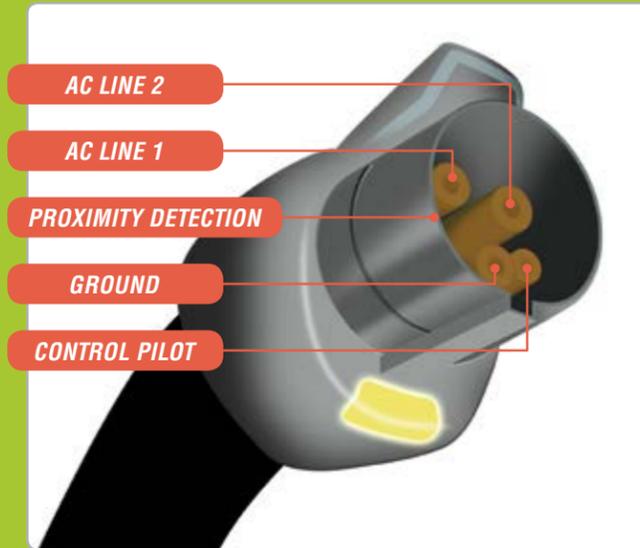


# CHARGING 101

## 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.



SAE J1772 Type Connector

SAE Standard	Description
J1772	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
J2293	Standard for the electric vehicle energy transfer system. This system encompasses what goes from the charging station to the car.
J2293-1	Functionality requirements and system architecture
J2293-2	Communication requirements and network architecture

More information concerning SAE, UL and NEC Standards can be found in the Applicable Codes & Standards section of Advanced Energy’s Charging Station Installation Handbook.

[http://www.AdvancedEnergy.org/Transportation/EVSE/Charging\\_Station\\_Installation\\_Handbook.php](http://www.AdvancedEnergy.org/Transportation/EVSE/Charging_Station_Installation_Handbook.php)



# CHARGING 101

## 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. In single-family homes and duplexes, charging stations are expected to primarily have one cord per enclosure. 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 charging will most likely occur at the vehicle owner’s home, many owners will be expecting workplace and public charging stations to be available as well. Effective implementation will require close coordination between electric utilities, municipal governments, local employers and retailers. Proper installation and safeguarding consumers are priorities, as is the development of appropriate training and certification programs.





# CHARGING 101

## Electrical Needs

The impact numerous PEVs will have on the power grid is heavily dependent on customer charging behaviors. If widespread primary charging occurs during peak load times, additional generation capability may be required. Customer charging also has the potential to impact equipment such as transformers, dramatically reducing their life and in some cases, causing them to fail. Ideally, methodologies will be in place to influence charging patterns, with the goal of most charging to occur during non-peak times.

Assuming customers charge at home at night, utilities can expect localized grid impacts, such as reduced transformer life, and will potentially need to upgrade local distribution lines/equipment to accommodate the increased load. As a general rule of thumb, the impact of a PEV is comparable to adding an average sized home to the local grid. With this in mind, adding 100 PEVs (100 home equivalents) to a city is negligible; however, adding 20 PEVs (20 home equivalents) to a subdivision with 100 residences is a 20% increase in load requirements and may require upgrades to the subdivision's localized distribution infrastructure.

Before purchasing and installing charging stations, there are some key questions business owners and municipalities need to ask, such as:

- ▲ What type of charging will take place, and how long will the average vehicle be parked in a particular space?
- ▲ What electrical service is available?
- ▲ What are the power requirements?
- ▲ What is the distance between the power source and proposed site? Are there obstructions/barriers?
- ▲ What are the Americans with Disabilities Act (ADA) requirements?
- ▲ Is there adequate lighting?
- ▲ Is the site in a flood plain or prone to water pooling during storms?
- ▲ Will the cords pose a trip hazard?
- ▲ How much will installation cost?

Electrical service may require upgrades to existing equipment and will need to be verified with the local service provider. Costs will vary on a case-by-case scenario, depending on new versus retrofit installation. There also may be federal grants and tax credits available to reduce costs.

## Possible Locations

Intended use, such as time-of-day charging, must be considered when determining the location of charging stations. It is important to:

- ▲ Know the intended user (public or private fleet)
- ▲ Understand space constraints
- ▲ Identify the location of the electric closet or panel
- ▲ Consider accessibility to walking paths, adherence to/consideration of the Americans with Disabilities Act requirements, and lighting requirements

Some general examples include:

### CHARGING AT HOME

- ▲ Charging scenarios vary greatly, from private garages, car ports and driveways to on-street parking, apartment lots, condominium lots and decks.
- ▲ Private garages will not require significant waterproofing and will likely not be exposed to impacts from vandalism or other actions.



# CHARGING 101

- ▲ Outdoor residential applications will require more durability and weatherization, as they are more exposed to the elements and impact.
- ▲ Single-family residences will likely not utilize charging stations with payment systems, as electricity use can be accounted for by the owner of the specific space; account information will not need to be recorded, tracked or communicated.
- ▲ On-street parking may potentially be the most onerous since there often is not a way to permanently reserve on-street parking spaces in most areas.
- ▲ Shared parking areas, such as at multi-unit dwellings and apartment complexes, may elect to utilize a more comprehensive station (similar to public stations) to provide a means to recoup the investment in infrastructure and electricity.

### CHARGING AT THE WORKPLACE

- ▲ Likely the second most common location for charging infrastructure.
- ▲ Charging occurs during the day and may overlap with a utility's peak hours.
- ▲ Can serve both fleet vehicles and company employees.
- ▲ Potential for multiple vehicles to use the same charging station leads to greater probability that the station may require data collection and communications capabilities.



### CHARGING AT RETAIL LOCATIONS

- ▲ Organization offers charging to customers, rather than tenants or employees.
- ▲ Charging will occur during the day and by multiple vehicles, which increases the need for charging control strategies and data collection.
- ▲ Retailers offering charging to customers may seek reimbursement for the cost of providing the equipment and electricity, though it is important to note that the resale of electricity is illegal in most states.

### PUBLIC

- ▲ Parking is provided by a municipality, other government organization or private company not seeking to sell any additional product or serve employee needs.
- ▲ Many organizations may look to provide free charging to either encourage the adoption of PEVs or provide an offering that will bring additional vehicles to a particular parking lot or deck.





# CHARGING 101

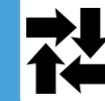
## Communications & Payment

Communications may exist between the vehicle, the charging station and a remote server. Communications may allow for locking/unlocking of stations, payment systems, power management, data collection and other features. There are a variety of communication protocols available and selection will depend on desired capabilities. Various payment models are currently being researched by electric utilities, charging station vendors and third-party retailers. It is important to note reselling of power is illegal in most locations throughout the U.S.; however, many retailers may look to find various means of recovering the cost of installation.

## Additional Considerations

As charging station technologies continue to evolve, there are additional items to keep in mind in terms of standard codes, structure and placement. For example:

- ▲ **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 life, safety and convenience.
- ▲ **Liability and Safety** Avoid placing stations in a major walking area and consider cord management systems to prevent tripping and cord damage.



# PLANNING 101 A ROADMAP TO SUCCESS

## Why is Proper Planning for Electric Transportation So Important?

In general, proper planning:

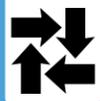
- ▲ Defines critical requirements
- ▲ Eliminates unnecessary work
- ▲ Streamlines necessary work
- ▲ Avoids implementation problems

Here are some of the specific reasons why good planning is important for PEV readiness:

- ▲ PEV infrastructure planning is complex. It is tempting to think of vehicle charging infrastructure as just another electrical appliance, no more or less difficult than installing street lighting, parking meters or simple electric distribution equipment; however, the cord connection between charging stations and vehicles and the interaction of users with the stations present unique challenges that must be accommodated.
- ▲ PEV-readiness planning bridges the activities of multiple departments, and as a result, may require additional relationship building, planning and coordination.
- ▲ Preparing for PEVs may support other pre-existing goals, such as air quality improvements, greenhouse gas emission reductions, fleet sustainability and adoption of renewable energy. As such, there are opportunities to realize multiple benefits from PEV-related efforts.
- ▲ Inexpensive decisions made in the short term have the potential to save lots of money in the future. For example, if you are modifying parking lots, parking garages, sidewalks or rights-of-way that may provide good charging station locations in the future, installing wiring and communications conduit during construction will save the expense of retrofitting that conduit after construction is complete.

- ▲ Proactively addressing requirements stemming from local ordinances, the ADA, historic districts and/or homeowners' associations may reduce the liability associated with non-compliance.
- ▲ Proper planning keeps your options open so you can more easily meet unforeseen needs in the future. A good question to ask now is "If we're installing 10 stations, what would we do differently if we were installing 1,000 stations?" Another important challenge is to select appropriate open-standard technology that provides the functionality needed without locking you into a proprietary technology design.
- ▲ Effective planning will properly integrate the electric load of vehicle charging with the existing electricity distribution system, in particular to avoid local problems such as the overloading of transformers.
- ▲ Effective training and education will help internal staff incorporate support for PEVs into their day-to-day thinking. Ideally, planning processes should evolve such that whenever there is a proposal for a new infrastructure project, it is evaluated for implications to PEVs.
- ▲ PEVs create the potential for economic development, both in terms of creating jobs for citizens and keeping more of drivers' dollars in the local economy.

Adding a new initiative on top of existing work is always a challenge, and that challenge is more difficult than ever due to an economic climate that has caused municipal revenues to fall, applying pressure to reduce staffing levels. Make the most of external partnerships to overcome these limitations and realize the benefits of great planning.



## Plotting Your Course

When exploring newer technologies, best practices demonstrate technology testing and verification are key to implementation. 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.

Advanced Energy recently developed an interactive, web-based tool that compares charging stations from various vendors across the U.S. Users can search based on vendor name, charging level needed, preferred mounting styles or products that have been certified by Nationally Recognized Testing Laboratories (NRTL) such as UL. Advanced Energy continues to review, analyze and evaluate technical information submitted by commercial vendors, service providers and other interested parties on charging stations, including, but not limited to:

- ▲ Charging station equipment and related systems/services
- ▲ Use of "smart charging" concepts
- ▲ Projected maintenance/repair schedules and costs
- ▲ Anticipated charging station billing models/systems, such as subscriptions, etc.

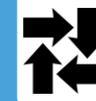
To accelerate the adoption of electrified transportation, success depends on the development and implementation of a technology-neutral strategic roadmap, which serves as a compass, providing detailed directions, lessons learned and best practices. Technology neutrality is vital to ensuring numerous systems and products are compatible with other offerings to promote a level marketplace.

Collaborative input from business, industry, government and academia will greatly contribute to your efforts and viability. Teams should work together to:

- ▲ Identify opportunities and explore/resolve issues and barriers associated with electrified transportation.
- ▲ Educate consumers on the viability of PEVs and overcome misconceptions or concerns that hinder adoption of new technologies.
- ▲ Establish a sound infrastructure to deliver a network of charging stations that meet the needs of vehicle owners without jeopardizing the stability of the power grid.
- ▲ Develop relationships with manufacturers to ensure availability of PEVs and charging stations.
- ▲ Explore opportunities for economic development.

➔ To learn more, visit: [www.AdvancedEnergy.org/Transportation/EVSE/Resources](http://www.AdvancedEnergy.org/Transportation/EVSE/Resources)

Depending on your role – from the electric utility that will supply the electricity for charging or fleet owners and city managers to business owners and end users – the road to implementation may be a newly paved, multi-lane super highway or a winding two-lane road with several speed bumps or even detours. For both paths, successful integration of electric transportation resides in the details.



## Key Collaborators

As stated, a fundamental component for success is the availability of PEV charging stations and related infrastructure. Effective implementation will require close coordination between electric utilities, municipal governments, property owners and local employers. Proper installation and safeguarding consumers are priorities, as is the development of appropriate training and certification programs.

### ELECTRIC UTILITIES

It will be important for municipalities to reach out to electric utilities as a partner in the process. The local/regional utility provider should be involved in all discussions related to charging infrastructure. The utility representative will provide valuable information and insight into how charging stations will impact the electrical grid and current power supply. Utilities will be responsible for ensuring charging capacity is delivered as expected and will need to review the potential impacts of increased loads. Working together from the initial planning stage can help ensure all aspects are reviewed and understood before moving forward.

While Level 1 charging will not cause much of an impact, Level 2 charging is akin to adding an extra house on a residential feeder circuit. If several PEVs are adopted by consumers within close proximity to each other (within the same subdivision), there is the potential for charging to overload the localized system or reduce the lifespan of the transformers. Initially, while volumes are relatively low, utilities can address these hotspots retroactively and managing load is not as critical. However, as PEVs gain acceptance and increase in volume, managing load will become increasingly important to ensure the grid can handle the added demand. For example, during peak load times in the summer, vehicle charging would have more of an adverse impact than

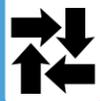
charging at night in the spring. Additionally, having the ability to manage load could provide benefits to utilities, ranging from load shaving to implementing localized choreographed load balancing that increases or decreases the load associated with PEV charging to keep kilowatt-hours at a more constant level. PEV charging also ties in well with future smart grid implementation.

### MUNICIPAL GOVERNMENTS

Municipalities will play a major role in encouraging the adoption of PEVs by influencing standards, codes, processes and policies. Departments within a municipality that should be involved include: Inspections, Planning, Public Works, City Manager, Fleet Management, Public Affairs and Sustainability.

Deciding to install public charging stations and physically doing it are two entirely different tasks. The first requires electric utilities, city managers and other decision makers to approve a concept. Aside from a few small demonstration projects, it is important to think about the economics when considering wide-scale installations and deployment.

Few municipalities are willing to spend large sums of taxpayer money on something that isn't guaranteed to provide a return or at least break even without having an extraordinary public benefit. Charging stations are costly compared to the cost of electricity, and municipalities are not allowed to charge for electricity in most states. Charging for a session may provide reasonable payback, but would require steady use or a much higher cost of fueling than would be incurred at home. Direct payback will be difficult to ensure with current prices. Instead, the initial focus should be on the public benefit, along with indirect cost recovery.



# PLANNING 101 A ROADMAP TO SUCCESS

## PERMITS & INSPECTIONS

Municipalities, permitting offices and other stakeholders must meet to agree on how permits and inspections will be handled. Best practices suggest permitting processes should be documented so that city and county governments can address unique issues related to installing charging stations. There may be numerous steps involved in receiving a permit to install a charging station and business and residential owners may not be aware of how long the process can actually take.

Potential barriers, such as lack of working knowledge of charging stations, may delay inspection, and municipalities should plan to educate inspectors on what qualifies as pass/fail for charging station installations. Different locations, such as on-street parking, parking lots/decks and charging at the workplace will also require different codes and permits. Municipalities will need to focus on zoning and building codes in order to determine the need and location for the necessary charging infrastructure.

The inspections department will play an important role in streamlining various processes associated with purchasing vehicles and installing infrastructure. When consumers purchase vehicles, they will likely need a charging station for their home. Typical home charging stations will require a 240VAC/40A dedicated circuit. Unfortunately, many homes do not already have this available and in many municipalities, a permit and inspection are required. The overall process will need to be streamlined to ensure a simple and timely installation of home charging stations.

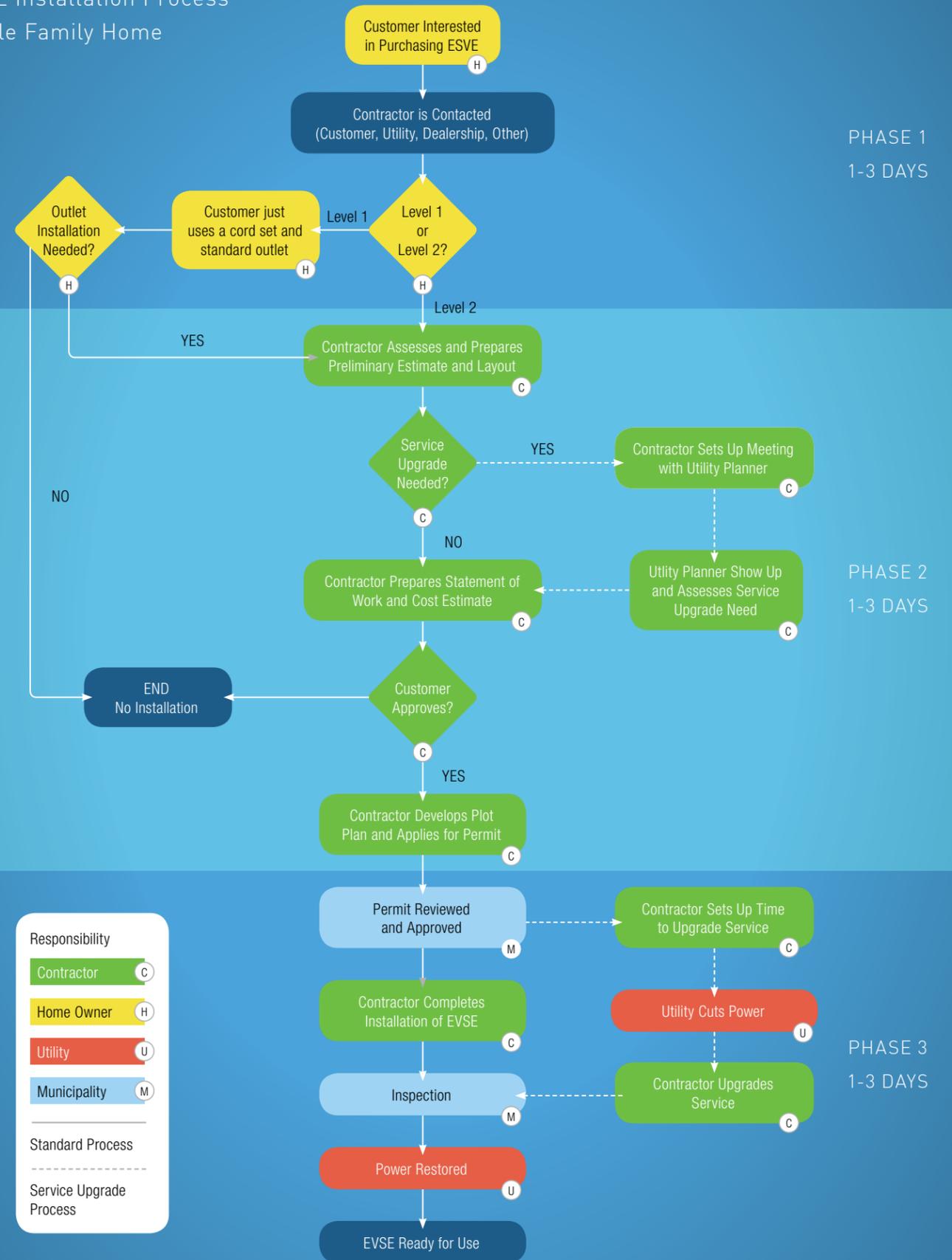
In many municipalities, there are a number of steps involved with receiving a permit, with two to three inspections required for the initial site, rough work and finished work. In addition, the permit application must be filled out with a level of detail that may be difficult for some. As charging stations are a new technology, the permit officers may not be familiar with all makes and models. The entire process may take upward of three or more weeks. While this may be sufficient for some projects, consumers will not want to purchase a vehicle without being able to charge it at home for several weeks.

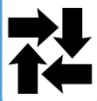
In order to expedite the process, there are several actions that are strongly recommended for the permitting and inspections departments.

- 1 Document any existing municipal permitting and inspection processes for obtaining a charging station permit, installing the charging station (including any assessment of electric utilities) and completing the inspection process, including contact information for main staff.
- 2 Confirm the existing municipal permitting process accommodates applications to install PEV charging stations in both private and public locations.
- 3 Create an expedited permitting process for PEV charging stations.
- 4 Create instruction sheets to guide installers and inspectors through the key requirements of charging station installations until they become mainstream.
- 5 Test the existing and/or improved municipal permitting and inspection process with inspectors and contractors to identify areas in need of improvement.
- 6 **MODIFY** codes or ordinances relating to new parking lots and garages to require a specific number or fraction of spaces be provided with conduit to serve both the power and communication wiring needs of future PEV charging stations, or to require a specific number or fraction of spaces be provided with PEV charging stations.

There are a number of barriers to implementing a simpler and quicker permit process. Understanding the structure and logic of the inspections department is important. The reasons for the department structure and for the existing processes may be driven by safety concerns. Nothing should change in a process if there is potential for public safety to be adversely impacted. As a result, eliminating some inspections or modifying a permit application may be difficult. Additionally, it is unlikely that permits will be granted for a technology that does not have certification from a NRTL such as UL. With manufacturers trying to reach the market early with new technologies, it is advisable to ensure all charging stations have been NRTL-certified. It will be extremely helpful if an approved list of charging stations is provided by the local utility or the vehicle manufacturers.

## ESVE Installation Process Single Family Home





# PLANNING 101 A ROADMAP TO SUCCESS

## CODES & STANDARDS

In addition to the permit process, municipalities should also explore appropriate code modifications. Zoning and building codes determine the standard for laying the infrastructure necessary for electric vehicles. Typically, parking structures tend to have less excess capacity available for charging stations. On-street and lot parking may require long wire run lengths and additional capacity, often with uncertainty of where to pull electric service from. Residential parking usually has available service capacity; however, there typically isn't a dedicated Level 2 circuit in the garage, carport or driveway. On-street residential parking will be an entirely different and more difficult scenario, which will require changes to codes and permits. And multi-unit dwellings will have a host of other considerations. New codes may be needed specifically related to parking and infrastructure. A few examples of new code changes from different municipalities across the country include:

- ▲ The ability to designate a parking space as 'electric vehicle only' and signage requirements
- ▲ The aesthetics and placement of the charging station may violate code
- ▲ Wiring requirements associated with installation
- ▲ Placement of the electric meter may be a challenge
- ▲ Differential pricing for spaces with charging stations
- ▲ Installation of conduit during renovation and new construction projects.

An idea being developed in North Carolina with potential national implications is a 'Plug-in Wired' and 'Plug-in Ready' standard. Plug-in Wired includes everything but the station – a dedicated 240VAC/40A circuit and applicable wiring. Plug-in Ready includes the dedicated circuit, wiring and charging station. Incorporating recognition of Plug-in Wired or Plug-in Ready from green builders' organizations, such as LEED, may drive groups toward participation. The development of this standard will require input and buy-in from electric utilities, municipalities and builders to ensure uniformity.

Standards and codes may also be important for individual parking spaces and structures (parking decks). Designers of these structures need to understand the requirements for charging stations. Parking spaces may need to be longer or sidewalks made wider to accommodate the additional space required by charging stations. Additionally, installation of conduit during major and new construction projects will make future adoption simpler by reducing installation costs. Considering that parking structures have a 50-year life, there is a strong case to make for small, relatively inexpensive design changes now to enable significant cost savings and versatility in the future. Some municipalities may choose to adopt standards and codes that promote these early steps.

## BUSINESS LEADERS

As more communities make the move toward electrified transportation, there is the ever-present need for local business leaders to serve as champions for innovative efforts and unique solutions related to electric transportation. Business leaders should investigate the benefits of electric transportation and supporting infrastructure needed now, based on:

- ▲ Anticipated likelihood of campus employees to adopt PEVs within the next two years
- ▲ Corporate commitment to accelerating the adoption of PEVs by their employees
- ▲ Ability to install charging stations on their campus
- ▲ Likelihood/feasibility of available resources they can commit to this initiative, including, but not limited to: dedicated staff time, financial resources, public/community relations campaigns, etc.

# STEPS FOR SUCCESS: COMMUNITY READINESS & PLANNING

## Collaborative Leadership

Municipal governments play two unique roles within their community that make them critically important in a community's effort to prepare for PEVs:

- ▲ Regulating and approving private charging station installations
- ▲ Controlling the placement & operation of public charging stations

These roles alone make the municipality the logical starting point for preparedness efforts in a community. Towns and cities are likely to take on other goals, such as purchasing PEVs to replace conventional vehicles in their own fleets or providing information about PEVs to citizens, which make them even more important as a hub for preparedness work.

This section describes a model of community planning for PEVs centered on municipal governments, relying heavily on partnerships with electric utilities, technical experts and product manufacturers.

## When Does My Community Need to Get Ready?

The first mass-market PEVs went on sale in U.S. in late-2010, but consumers should be aware when PEVs are arriving in their area. Manufacturers will continue to expand into new markets based on lessons learned in the initial rollout communities; therefore, it is reasonable to assume some communities need to begin planning and preparing sooner than others. Rural areas are not as likely to see significant volumes of PEVs for several years, but if your community has citizens who regularly commute to a rollout community, then preparing for consumer adoption should be on your agenda.

Another way to look at planning for PEVs is that by implementing a community plan to support adoption and by fostering interest in purchasing the vehicles, a town or city will attract greater interest from manufacturers to introduce PEVs to that community. If this is desired, then it makes sense to start planning even though there may not be an imminent influx of PEVs.

Planning tasks that allow a community to answer "Yes" to the following questions make it more likely for that community to receive vehicles:

- ▲ Does the local code compliance process allow for convenient permitting and installation of private or public charging stations?
- ▲ Do local ordinances support installation of public charging stations?
- ▲ Are there active outreach campaigns to educate consumers on the benefits of PEVs?
- ▲ Are there local groups championing PEVs?
- ▲ Are there local incentives for the purchase of PEVs?
- ▲ Have local governments committed to purchasing PEVs for their fleets?
- ▲ Have local businesses, taxi services, or car rental agencies committed to offering PEVs?
- ▲ Is there a strong dealer network prepared to sell PEVs?

Other considerations may indicate your community is likely to be early adopters of PEVs, including:

- ▲ Wide spread adoption of hybrids such as the Toyota Prius and Honda Civic
- ▲ Local average vehicle miles traveled (VMT) is under 40 miles per day

There are more than one million electric vehicles already on the road today ranging from electric motor bikes, to NEVs to PEVs. It now appears to be less of a question of whether PEVs will be broadly adopted in the market and more a question of knowing your local government, electric utilities and other key stakeholders will be ready to support the demand when it occurs.

# STEPS FOR SUCCESS: COMMUNITY READINESS & PLANNING

## My Community Needs to Get Ready for PEVs. How Do We Start?

Preparation for electric vehicles begins with a good plan. It may be tempting to jump forward with implementation, but experience in rollout cities has shown the benefits of taking the time to assemble a planning team, educating the planning team on PEVs and defining short- and long-term goals.

Your planning team typically starts with one person agreeing to take the lead as an organizer. If your city or county has a sustainability manager, they are a natural candidate for this role but there are many good options: the city/county manager, planning or inspections director, facilities or public works director, or fleet managers are all potential champions for PEV readiness.

Depending on the standard operating procedures, structure and culture of your organization, you might also include representatives of public affairs, parking departments and board or council members.

Your first step is to educate this planning team on the fundamentals of PEVs:

- ▲ How do PEVs compare to conventional vehicles? What are their pros and cons?
- ▲ What are the types of PEVs entering the market and when are they expected?
- ▲ What types of equipment are available for charging the vehicles?
- ▲ What are the key permitting and inspections processes related to charging stations?
- ▲ What consumer incentives are available for vehicles and charging stations?
- ▲ What are effective organizational structures and tools for planning and implementation?
- ▲ What resources are available for additional technical support?

This guide is intended to answer many of these questions, but you will also need your planning team to hear from a knowledgeable representative of your electric utility, experts from academia or industry and/or independent consultants, such as Advanced Energy, to ensure your team has the most up-to-date information.

If there is a likelihood that your community's goals will go beyond the minimum requirements of having appropriate permitting and inspections processes, you may want to include utility representatives and technical experts on your planning committee right from the start instead of beginning with a smaller team that expands as you define your goals.



Preparation for electric vehicles begins with a good plan. It may be tempting to jump forward with implementation, but experience in rollout cities has shown the benefits of taking the time to assemble a planning team, educating the planning team on PEVs and defining short- and long-term goals.

# STEPS FOR SUCCESS: COMMUNITY READINESS & PLANNING

Appropriate permitting and inspections processes are noted as “minimum requirements” because regardless of whether a community sets any other goals, the municipality must be prepared to support the efficient and safe installation and operation of charging stations by private citizens at their homes or places of business.

Examples of going beyond these minimum requirements could be:

- ▲ Installing publicly available charging stations in your community
- ▲ Purchasing PEVs for your fleet
- ▲ Offering reserved parking spaces for PEVs
- ▲ Providing educational PEV resources for your citizens

### TO REVIEW, YOUR COMMUNITY STARTS THE JOURNEY TO PEV READINESS BY:

- Identifying an internal champion to organize the planning process
- Assembling an internal PEV planning committee
- Providing the planning committee with basic PEV information
- Including external partners as appropriate

## Why is including External Partners Important?

It would be great if getting prepared for PEVs could be accomplished by simply checking off tasks on a one-size-fits-all list. Unfortunately, there is a good deal of variability in which tasks are appropriate and feasible for a particular community. It is critical to have the right information when it is needed, along with proper guidance to analyze your options and make effective choices.

Good partners help you understand the options available for PEV readiness and then help you select appropriate

goals for your community. They will then help you plan for and carry out implementation of those goals. There are two types of important partners:

- ▲ Electric utility representatives
- ▲ PEV technical experts

Helpful utility partners may represent a variety of roles within the utility, such as government and community relations, infrastructure planning or power delivery. Other technical experts may be found at local universities, community colleges, businesses (especially manufacturers of vehicles or charging stations), federal and state agencies, non-profit organizations and enthusiast groups.

Another type of partner, policy planners, may be needed if you are creating a local community plan (i.e., for one particular city or county) and there is a need or desire to integrate that local plan with a regional or statewide plan. Such partners might come from a metropolitan planning organization or a council of government.

More specifically, there are four key types of support external partners bring to your planning team:

- ▲ **Facilitation** Partners help guide planning and implementation, sharing project management tools, strategies and feedback as needed. New communities benefit from the work done and lessons learned in communities that are farther along in their work.
- ▲ **Decision Support** Partners supply detailed technical information on vehicles, charging stations and related technologies and help to define both impacts on existing infrastructure as well as requirements for new infrastructure.
- ▲ **Relationship Building** Partners identify previously unknown barriers, work to ensure the availability of necessary products or services and seek economic development opportunities.
- ▲ **Outreach** Partners help to educate consumers and other stakeholders about vehicle and charging station technologies, explaining benefits, drawbacks and common misconceptions.

# STEPS FOR SUCCESS: COMMUNITY READINESS & PLANNING

## What Goals Should I Consider for My Plan?

There is a broad range of options available to organizations looking for ways to support the adoption of PEVs. While this creates a challenge in the sense of needing to evaluate a lot of choices, these choices will provide decision makers with numerous options appropriate for every organization.

The overall set of options can be divided into six categories:

- ▲ Steering Committee (guides and oversees implementation)
- ▲ Standards (policies, codes and ordinances)
- ▲ Charging Stations (selection, surveying, site assessments, installation and operation of charging stations)
- ▲ Vehicles (vehicle selection, assignment and operation)
- ▲ Incentives (benefits provided to PEV owners and operators)
- ▲ Outreach (education and partnership development activities)

The following sections describe each category in more detail and provide a menu of goals your organization may choose to incorporate in its PEV plan.

### STEERING COMMITTEE

Most organizations will find it helpful to set up a steering committee to guide and oversee implementation. This committee can be comprised of the same members who selected the goals for the PEV readiness plan, along with key external partners, such as utility representatives and technical experts. Other partners, such as equipment manufacturers, can be included intermittently as needed.

Within the municipal structure, the heads of departments will typically be on the steering committee, though anyone with the direct ability to allow or prevent action should be included. Specific departments to represent may include Sustainability, Public Works, Inspections, Planning, Transportation, Fleets, Public Affairs and the City or County Manager's Office.

Besides coordinating and overseeing the efforts occurring in the different work areas, the Steering Committee will set deadlines and establish tools for tracking progress toward specific goals as well as for recording completions and major accomplishments. The Committee should define systems for documenting research, resources, conversations and decisions, as well as a system for mapping proposed and completed station locations. Other tools might include a system for producing and cataloging training materials.

The Steering Committee will be responsible for identifying assistance needed from external partners and coordinating with their representatives to obtain that assistance. For example, this might be a community college offering classes in PEV maintenance, a corporate partner that can secure grant money for charging station installations, or an independent consultant to collect and analyze data. Committee members will likely interact with their peers at similar organizations to share information or ideas and to solve problems.

Another responsibility of the Steering Committee will be to recruit or assign appropriate staff to work on implementation of the goals in each work area. If there are adequate resources, the organization may be able to create dedicated work groups that hold additional meetings and pass information back to the Steering Committee more formally. Most organizations will have limited resources, such that members of the committee will work on goals from multiple categories. This will necessitate prioritizing the goals and scheduling so as not to overload team members.

To recap, the Steering Committee is responsible for:

- ▲ Coordinating and overseeing efforts of all the work areas
- ▲ Setting deadlines
- ▲ Establishing tools for tracking progress
- ▲ Recording completions and major accomplishments
- ▲ Defining systems for documentation
- ▲ Identifying assistance needed for external partners
- ▲ Recruiting/assigning staff to work on implementation of the goals.

# STEPS FOR SUCCESS: COMMUNITY READINESS & PLANNING

### STANDARDS

The Standards work area covers documentation of and modifications to existing municipal, state, utility or business policies related to PEV charging stations, particularly permitting requirements, building codes and development ordinances. The overarching goals are to:

- ▲ Identify and eliminate processes or requirements that may unintentionally inhibit the installation of PEV charging infrastructure.
- ▲ Support the creation of codes or ordinances that foster appropriate charging infrastructure.

PEV manufacturers intend to make PEVs available in all 50 states within the next several years

Permitting is important to address, as communities with a streamlined charging station permitting process

are looked upon favorably by PEV manufacturers and make adoption easier for consumers. In the 1990s one major obstacle to the adoption of PEVs was the amount of time it took to install a charging station – almost three months! Customers who purchased a PEV were unable to charge their vehicles at home until they installed their residential charging station, which required a permit. This was less than ideal and PEV manufacturers want to avoid making the same mistake again. As such, they are targeting states for early launch with communities that are actively addressing the permitting process as well as related local building codes. With that said, it is important to note PEV manufacturers intend to make PEVs available in all 50 states within the next several years.

Aside from the permit process, the municipality will be the group to focus on for any code modifications as zoning and building codes determine the standard for laying the infrastructure necessary for electric vehicles.

In the short term, the low volumes of PEV purchases in any one community will allow permitters and inspectors to identify

problems without significant delay. Such problems must be eliminated so that they do not cause a delay as volumes increase. Several jurisdictions have implemented one-hour or same-day permitting depending on location and time of submittal, and many locations also have same-day inspections.

Another key area to review is local ordinances. Ordinances may determine when someone has to go through the permitting process and may impose additional restrictions or requirements, some of which may be prohibitive.

### Standards-Related Goal Options:

- ▲ Document any existing municipal permitting and inspection processes for obtaining a charging station permit, installing the charging station (including any assessment of electric utilities) and completing the inspection process, including contact information for main staff.
- ▲ Confirm the existing municipal permitting process accommodates applications to install PEV charging stations in both private and public locations.
- ▲ Create an expedited permitting process for PEV charging stations.
- ▲ Create instruction sheets to guide installers and inspectors through the key requirements of charging station installations until they become mainstream.
- ▲ Test the existing and/or improved municipal permitting and inspection process with inspectors and contractors to identify areas in need of improvement.
- ▲ Modify codes or ordinances relating to new parking lots and garages to require a specific number or fraction of spaces be provided with conduit to serve both the power and communication wiring needs of future PEV charging stations, or to require a specific number or fraction of spaces be provided with PEV charging stations.

# STEPS FOR SUCCESS: COMMUNITY READINESS & PLANNING

## STATIONS

The Stations work area is somewhat different from the other work areas. Instead of having a sizable menu of possible goals to choose from, there are just two:

- ▲ Install a certain number of PEV charging stations for internal use and/or
- ▲ Install a certain number of PEV charging stations available for public use.

The options in this work area include choices that must be made prior to and during the installation process, covering tasks related to the selection, surveying, site assessment, installation and operation of the charging stations. Naturally, installing charging stations for internal use only is contingent on the planned purchase of one or more PEVs.

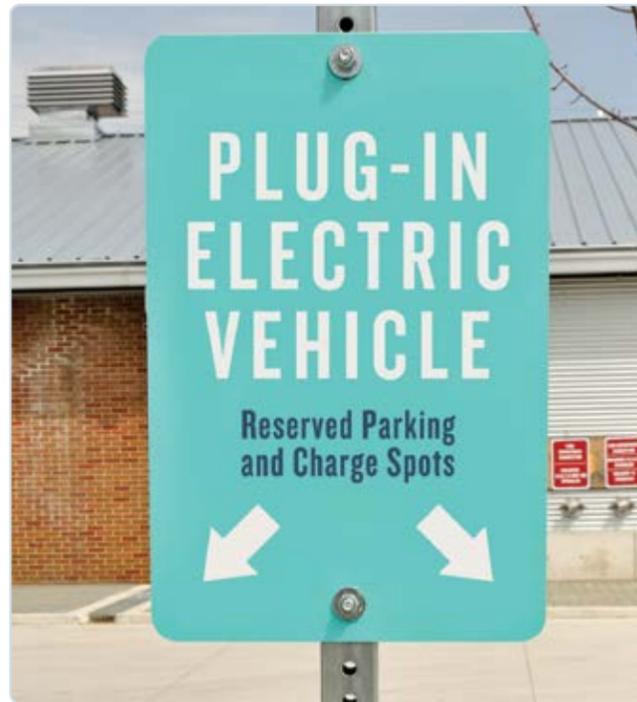
While research shows PEV owners will do the vast majority of vehicle charging at home, the availability of public charging stations has a significant effect on reducing a driver's range anxiety – the concern they might run out of charge before they reach their destination. Thus, a community's decision to install public charging stations is a strong indicator of support for PEVs. As such, proper placement in the municipality for the initial stations is important and should be addressed.

When planning charging station infrastructure, a good question to ask in the beginning is, "If we are installing 10 stations, what would we do differently if we were installing 100 stations?" Would you make the same design and surveying choices? Would you put your first ten stations in the same place?

In preparation for implementation, most steps apply whether the charging stations are intended for internal or public use. The following should be considered:

## VISIBILITY

It is important that charging stations be visible to both vehicular and pedestrian traffic for a number of reasons. Selecting a highly visible site will increase exposure of the general public



to charging infrastructure, increasing familiarity and comfort with electric transportation. In addition, such a location will ensure that drivers are able to find and use the charging station(s). Finally, visible sites will reduce the potential for vandalism and theft of charging station components.

A highly visible location has direct line of sight from a publicly accessible right-of-way, such as a road or sidewalk. Busier locations should typically be selected over the more remote. Visibility to vehicles can be partially increased through the installation of way finding signs. This will improve the ability for drivers to find infrastructure, but may not improve exposure and reduce vandalism. Well-lit and secured parking areas will reduce the likelihood of vandalism.

## TIME CONSIDERATIONS

A general industry assumption is that the first generation of PEVs will achieve approximately 10 to 15 miles of range for every hour of Level 2 charging, though this will vary based on PEV charging capacity, battery characteristics and ambient conditions. For most communities priority should be given to locations where

# STEPS FOR SUCCESS: COMMUNITY READINESS & PLANNING

PEVs will likely be parked for one to two hours. This will allow the vehicles enough time to cool down, begin charging and gain enough charge to suitably extend a vehicle's range.

Daily parking may provide less benefit to vehicle owners than hourly parking. If vehicles have a tendency to remain in a parking location for more than four hours, it will be likely that the vehicle will be fully charged and occupy a space that could be serving additional vehicles. While these spaces will still benefit drivers, spaces where drivers park for two to four hours should be given greater priority. Spaces for employees or fleet vehicles will require longer dedicated time periods and should not be restricted to less than four hours.

Level 1 charging should be considered for long-term parking spaces, such as at airports. In some cases, Level 1 charging may provide less communication capability. Site owners should assess the benefits and features of charging stations based on cost and need.

## ENVIRONMENTAL CONDITIONS

Weather can cause both real and perceived issues with charging infrastructure. Charging stations can be installed both indoors and outdoors, and station enclosures can be selected to withstand various environments. Certain conditions should be planned for or avoided. Locations prone to flooding or in areas where standing water is present may result in decreased use of infrastructure due to perception of safety risk. In addition, charging stations are not typically designed for submersion



and have potential to be damaged if installed in flood plains. Areas where snow is piled can also significantly reduce use of infrastructure and may result in damage or degradation. Salt may also impact the life of a charging station for certain enclosures. All conditions should be evaluated prior to selecting a site.

## POWER AVAILABILITY

Sites should be evaluated for existing power capacity within the nearest panel as well as at the supplying transformer. Many locations, including parking decks, may have limited capacity beyond one or two charging stations. Proximity of parking to a power source is also important in saving cost due to less conduit, cable and labor. These considerations should be quantified and documented during the site assessment stage to make an informed decision of benefit verses cost.

Planned parking locations and those under construction will greatly benefit by planning for excess power capacity and laying conduit for future charging infrastructure. If power upgrades are required for a location, planning for additional charging stations in advance has the potential to significantly reduce future installation costs.

## COMMUNICATIONS

Charging station owners will need to determine whether they desire remote communication to and from the charging station(s) to be installed. This may be for gathering usage information, for restricting use and for billing options to name a few. If such communication is required, it will be important to select a site that is viable for the selected 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.

# STEPS FOR SUCCESS: COMMUNITY READINESS & PLANNING



## STATIONS CONTINUED

### BILLING NEEDS

It is important to determine whether it will be necessary to bill vehicle owners for use of infrastructure. If this is a requirement immediately or in the future, it will be important to select a station that can handle billing, infrastructure that can be upgraded or to install infrastructure in a location where billing can be handled with existing resources.

### GEOGRAPHICAL DISTRIBUTION

Public charging stations serve a function in promoting range confidence. When considering potential locations for charging infrastructure, it is important to maximize the number of locations to which range can be extended. Drivers will have more confidence in purchasing an electric vehicle if charging infrastructure is within range of their typical destinations. It is important to note that public infrastructure should not be planned to serve as a primary means of charging for vehicles.

Municipalities may provide greater benefit to citizens by installing infrastructure in locations where private parking is not located nearby, such as museums, parks, libraries and other high-traffic attractions. Commercial property owners, employers and neighboring municipalities may install infrastructure in addition to

what municipalities install. Knowledge and coordination of these installations will result in better overall placement of infrastructure.

Additional tasks include:

- ▲ Define the appropriate surveying criteria for charging stations.
- ▲ Identify and prioritize potential locations for charging stations. Some potential options for public stations include:
  - + Parking lots/decks
  - + Schools
  - + Libraries
  - + Service Yards
  - + Offices
  - + Fire & Police Stations
  - + Cultural Venues
  - + Parks
- ▲ To the extent possible, coordinate with other public organizations and/or private companies to avoid unnecessary overlap in charging station installations. Popular options for surveying stations include offices, shopping centers, colleges, universities, hospitals and entertainment venues.
- ▲ Determine whether site evaluation, design, installation and management will be performed by staff or contracted out.
- ▲ Define the desired policies for key issues:
  - + Technology neutrality/interoperability
  - + Equipment ownership
  - + Functionality
  - + Communications
  - + Limitation of liability
  - + Reserved parking status
  - + Fees for charging sessions
  - + Energy data collection
  - + All associated costs for the next five years

# STEPS FOR SUCCESS: COMMUNITY READINESS & PLANNING

As most charging stations are new equipment, sites have many variables and manufacturers may have varying levels of interest in serving specific territories. Expect significant variation in bids for charging station installation projects.

An additional important consideration is ADA accessibility. In many states, all public lots and decks, including those of retailers and employers, require a minimal proportion of charging stations must support a handicapped-reserved parking space.

## VEHICLES

The Vehicles work area covers goals related to incorporating PEVs into municipal operations. Team members who work in this area will answer questions about the suitability and cost-benefit comparison of PEV use versus the use of conventional ICE or hybrid vehicles.

There are many new models, many by new vehicle manufacturers, coming to the market within the next two- to three-years. This will make it more challenging for buyers to be up to speed on all the available technologies and options. Online resources from the Electric Drive Transportation Association (EDTA) and Rocky Mountain Institute (RMI) provide extensive up-to-date information on manufacturers' offerings. They also have links to tools that will help buyers assess which vehicles are appropriate for their needs and to calculate Total Cost of Ownership for cost comparisons to their existing vehicles.

Vehicle-Related Goal Options:

- ▲ Calculate the Total Cost of Ownership of PEVs relative to the typical ICE counterpart in your fleet.
- ▲ Define the vehicle applications in your fleet that are appropriate options for substitution of PEVs for ICE vehicles (considering passenger and/or payload requirements, daily range requirements, operating conditions and routes, parking and charging facilities, etc.).
- ▲ Survey department staff for interests in and objections to the use of PEVs, as well as usability and maintenance questions.
- ▲ Commit to purchase a defined number of PEVs for use in municipal operations.

## INCENTIVES

The Incentives work area covers efforts to define and evaluate various benefits a municipality could provide to encourage its citizens and/or employees to become PEV owners or drivers. Team members working on incentives will also identify benefits available from sources other than the local municipality and provide this information for use in outreach activities.

The most significant incentives are at the state and federal level, so implementation of local incentives might seem to be small scale and straightforward. However, one concern has been raised with regard to allowing free charging from public stations: that taxpayers would be funding the cost of vehicle charging for a select few actual users. This will not likely be a major concern while numbers of PEVs are low and much of the cost for stations is being subsidized. However, municipalities are advised to take the long view and let users know paying for charging will most likely be required, even if it is currently free.

Incentive-Related Goal Options:

- ▲ Provide free, reserved parking for PEVs in preferential locations.
- ▲ Provide free charging at charging station locations.
- ▲ Identify any available rebates, tax credits or other incentives available to residents from state and federal sources. This may include transit-related benefits on state and federal roads, such as access to HOV lanes for PEVs regardless of vehicle occupancy.
- ▲ Research applicable preferential electric rates available to residents from local utilities, such as time-of-use rates for off-peak charging.
- ▲ Identify any preferential vehicle loans for PEVs available to residents from local lenders.

# STEPS FOR SUCCESS: COMMUNITY READINESS & PLANNING

## OUTREACH

The Outreach work area covers management of the knowledge gained through implementing goals in the other work areas and dissemination of that knowledge to appropriate partners and the public. Outreach efforts should be tailored to each audience based on their specific needs and goals, and generally need to be repeated several times to successfully convey information. Advertising outreach efforts regionally can help bring several municipalities up to speed simultaneously.

A proven way to launch a community's engagement with preparing for PEVs is to assemble a meeting of municipal staff, starting with the planning, inspections, facilities, sustainability, fleets and management staff if possible. Have a technical partner or knowledgeable insider to present on the basics of electric vehicles, charging stations and community planning. From there, it is useful to schedule a series of working meetings to assess where the community is, whether there are objections to overcome, and to start planning the path forward. These meetings will help to:

- ▲ Start assessing preparedness for private residential permitting & inspections.
- ▲ Begin to identify municipal goals and work areas.
- ▲ Start the planning for a technical forum for inspectors and installers.
- ▲ Identify who to invite to a community forum in order to continue education and outreach efforts.

If you are collaborating with partners to develop presentations and educational materials that may be used in other venues or used for professional services, be proactive in discussing the ownership of intellectual property and use of corporate logos in order to avoid later conflicts.

Once you've made the decision to go green and incorporate PEVs into your organization or community, you'll need to educate all stakeholders. Through Advanced Energy's experience, we've discovered there are numerous audiences who could be impacted by the innovative solutions you've chosen to put in place.

Education and outreach campaigns need to be specifically tailored to each audience based on their specific needs and goals.

Municipalities and business owners can increase exposure by building enthusiasm and support for programs through outreach activities such as:

- ▲ Media days
- ▲ Fact sheets
- ▲ Newsletters
- ▲ Users groups
- ▲ Papers and articles
- ▲ Webinars and teleconferences
- ▲ Workshops, conferences and meetings
- ▲ Links to PEV resources on websites

Training will be a key factor for success. Advanced Energy recommends at minimum the following:

- ▲ Charging station user information sessions
- ▲ Equipment education and training for inspectors and installers of charging stations
- ▲ Driver training for consumers (or for employees who will be driving electric fleet vehicles)

# STEPS FOR SUCCESS: COMMUNITY READINESS & PLANNING

Outreach-Related Goal Options:

- ▲ Provide or promote technical trainings for key stakeholders:
  - + Electricians and electrical inspectors
  - + First responders (police and fire departments)
  - + Vehicle maintenance and repair technicians
- ▲ Document general information about PEVs and purchase incentives for citizens and/or employees and provide references to existing resources, both in print and online. Formats can include:
  - + Fact sheets
  - + Newsletters
  - + Papers and articles
  - + Web-based databases, blogs and forums
- ▲ Build relationships between key partners, such as PEV and charging station manufacturers, local PEV and charging station dealers, public and private fleet managers and facilities managers in order to share basic PEV information and foster commitments to purchase.
- ▲ Coordinate overview presentations of basic PEV infrastructure and community planning information to other area community organizations such as your:
  - + Chamber of Commerce
  - + Homebuilders' Association
  - + Neighboring communities
  - + Regional Council of Government (COG) and/or Municipal Planning Organization (MPO)
  - + Large institutions (e.g., colleges and universities, hospitals, etc.)
- + Large businesses
- ▲ Share goal-specific accomplishments and relevant background information via:
  - + Media days
  - + Webinars and teleconferences
  - + Workshops, conferences and meetings
- ▲ Schedule drive-and-ride events for manufacturers to bring their vehicles to your community and allow test drives of new PEVs.
- ▲ Provide driving tips for consumers (or for employees who will be driving electric fleet vehicles) to help them obtain the best vehicle performance.

# FROM CONCEPT TO GO: IMPLEMENTATION AND INTEGRATION

## Implementing Your Plan

As with any other initiative, achieving the goals you choose for PEV readiness requires effective leadership, management, implementation and communication. There is not one “right” way to implement the plan, so take advantage of the particular strengths and flexibility of your organization as much as possible.

You might designate a single point person, or “champion” for the initiative as the primary decision-maker and/or communicator for planning and implementation, or your organization may have other protocols and requirements for decision-making, such as going before a board or council for approval. Financial requirements will vary significantly among municipalities and businesses. Some have stricter oversight or approval mechanisms than others with regard to what measures and expenditures must obtain approval from elected or corporate officials. Smaller organizations may need to consider contracting tasks if they have limited staff, while larger organizations may complete the work themselves. Communication may be more or less formal, relying on everything from regular structured meetings to informal electronic correspondence.

## Ready? Set? Go!

Automotive manufacturers are conducting extensive media and advertising campaigns as their vehicles move off the production line and into communities. As such, most consumers should be aware that PEVs are arriving in their area. The benefits of owning and operating a PEV, as well as the steps communities and businesses are taking to embrace these new vehicles should be highlighted and publicized as well. Having credible, informative messages delivered from trusted sources such as mayors, community leaders and executives will help increase public adoption.

PEVs will not be equally available throughout the United States. Manufacturers will be launching vehicles in select markets first and expanding into new markets based on a number of key factors. As such, some areas may need to begin planning and preparing sooner than others.

As a general rule of thumb, PEVs will likely first arrive in volumes in population centers (cities and their suburbs). Rural areas are not likely to see any significant volumes of PEVs in the first several years. Hence, if you are in or are in close proximity to a medium to large city, you should expect PEVs to be arriving in your area within the next one to three years. If this is the case, then you should begin to prepare immediately.

With PEVs already a commercially viable option, these vehicles will become increasingly more available and in higher demand. It's not a question **if** PEVs are adopted into mainstream culture – it's knowing that **if** your town, local government, public utilities, permitting offices, residential home builders and other key stakeholders will be ready to support the demand **when** it occurs. Remember to involve key stakeholders in all planning and decisions, work cohesively and collaboratively to identify resources needed, address impending issues and implement technology-neutral charging infrastructures. Education, outreach and training are key factors to success, and will help you embrace the “vehicles of tomorrow” today.

# GLOSSARY

## Charging Station

Device that transfers power to the PEV while providing proper grounding, shock protection and overload protection.

## Electric Vehicle Supply Equipment

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.

## Mounting Style

Refers to placement/location of charging stations such as: Floor, Wall, Ceiling or Pole.

## Power Supply Owner

Depends on location; can have a variety of owners ranging from the electric utility to the customer. Important to identify the owner of the power supply and develop an agreement that allows for the power supply to be used. Note: if the customer is not the parking and power supply owner, it will be important to provide information to each group prior to any installation work.

## UL Standards

Safety standards for charging electric vehicles developed by Underwriters Laboratories

## Acronyms

AC	Alternating Current
ADA	Americans with Disabilities Act
COG	Council of Government
DC	Direct Current
EREV	Extended Range Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
ICE	Internal Combustion Engine
MPO	Municipal Planning Organization
NEC	National Electrical Code
NEV	Neighborhood Electric Vehicle
NRTL	Nationally Recognized Testing Laboratory
PEV	Plug-in Electric Vehicle
PHEV	Plug-in Hybrid Electric Vehicle
SAE	Society of Automotive Engineers
UL	Underwriters Laboratories
VAC	Voltage Alternating Current
VMT	Vehicle Miles Traveled

# RAMP UP YOUR KNOWLEDGE

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 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/resources>.

## Prepare for the Road Ahead

Preparation for electric vehicles begins with a good plan. It may be tempting to jump forward with implementation, but experience in rollout cities across North Carolina has shown the benefits of taking the time to assemble a planning team, educating the planning team on PEVs, and defining short- and long-term goals.

It's not a question of if PEVs are adopted into mainstream culture – it's knowing that your local government, public utilities, permitting offices, electricians and code inspectors and other key stakeholders will be ready to support the demand as it occurs. We can help!

From stakeholder development and decision support to on-site assessments, performance evaluations and codes and standards guidance, our unique model allows us to guide you remotely – providing the technical knowledge to keep you on track and moving forward.

Advanced Energy's "Train-the-Trainer" approach builds your local training capacity, providing you with the ongoing capability to educate staff and new hires. Through classroom style and hands-on workshops, we work with communities to initially educate trainers on performing the critical details needed for successful completion of the tasks mentioned throughout this handbook. Additionally, our courses can also be customized to fit your specific needs.

Proper planning defines critical requirements, eliminates unnecessary work, streamlines necessary work and avoids implementation problems. Collaborative input from business, industry, government and academia will greatly contribute to efforts and viability. Advanced Energy also offers a Community Planning Guide to Electric Transportation to help communities:

- ▲ Identify opportunities
- ▲ Educate consumers
- ▲ Establish a sound infrastructure
- ▲ Develop relationships
- ▲ Explore opportunities for economic development

# WHY ADVANCED ENERGY?

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. We get excited about solving problems that no one else has solved, and we embrace new ideas and new ways of thinking. Our passion is to stimulate communities, utility partners and consumers with innovative technologies and ideas, to offer solutions, and to bring transformation and viability to the marketplace, enriching the lives of many.

Advanced Energy's Electric Transportation Initiatives Team is working to assist communities in understanding, planning and implementing electric transportation initiatives. An established figure in the development and deployment of plug-in electric vehicle technologies, Advanced Energy has worked with our utility partners since 1991 to understand the potential of electric transportation through the conversion of several vehicles to all electric. We shifted our focus in 2001 from all electric vehicles to plug-in hybrids with the creation of the Plug-In Hybrid Electric School Bus Program. In 2003 we issued a comprehensive study showing the potential energy and emissions benefits of creating plug-in hybrid school buses. Through partnerships developed by Advanced Energy, we successfully facilitated the creation the world's first commercially available plug-in hybrid vehicle through this program in 2007.

Advanced Energy also works with municipalities, electric utilities and National Laboratories monitoring and evaluating the performance of numerous fleets of plug-in hybrid vehicles across the country. Advanced Energy currently manages the NC Get Ready program to accelerate the adoption of electrified transportation in North Carolina – one of the key initiatives in the nation making a true commitment to the widespread acceptance of electrified transportation. NC Get Ready is supported by a consortium of cities, government officials, industry leaders and not-for-profit organizations. The electric utilities Progress Energy and Duke Energy are also key supporters of this initiative. Today we continue to advance electric transportation through associations, supply-chain consulting, applied research, and decision support. For more information, visit [www.AdvancedEnergy.org](http://www.AdvancedEnergy.org).



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