



Southwest Energy Efficiency Project

Saving Money and Reducing Pollution through Energy Conservation

What Can Cities and Counties Do to Promote the Deployment of Electric Vehicles?

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1. Introduction

Plug-in Electric Vehicles (PEVs) from original equipment manufacturers (OEMs) are now available to the public in the United States (see Attachment A for a listing of PEVs). Some cities and counties have already started preparations to create infrastructure that will facilitate their use, and extend their operating range. Some local governments have more experience than others and may have some lessons learned and best practices that can be shared with those cities just beginning to determine how to plan for the arrival of PEVs.

This report lays out some of the best practices by municipalities who have undertaken this effort. It must be recognized that the development of infrastructure and policies for the support of PEVs is new and is developing rapidly. New information is continuously emerging regarding the best practices being implemented by city and municipal governments. This report provides a guide for municipal governments interested in exploring options for better preparing their communities to support the optimal use of PEVs and their charging infrastructure. The report is organized by subject area, with an examination of what different governments have done to prepare for the arrival of PEVs in each subject area.

1.1 Why Local Governments are Promoting the Use of PEVs

PEVs offer the potential for the reduction of gasoline consumption, driving costs, CO₂ emissions and improved local air quality. A Battery Electric Vehicle (BEV) does not require any gasoline to operate, while a plug-in hybrid electric vehicle with a battery range of 10 miles (PHEV 10) and a plug-in hybrid electric vehicle with a battery range of 40 miles (PHEV 40) would reduce gasoline consumption by 46% and 73% respectively compared to a new gasoline-only powered car. Including the additional cost of electricity to power the batteries, a BEV would reduce the cost of driving by over \$1,000 annually, while a PHEV 10 would reduce costs by nearly \$600 and a PHEV 40 by over \$900 compared to a new gasoline powered car. Annual CO₂ emissions from a BEV would be approximately 1.5 tons less than a new gasoline powered car, while a PHEV 10 would reduce emissions by 1.2 tons and a PHEV 40 by 1.3 tons.¹ PEVs also should reduce tailpipe emissions of the ozone precursors NO_x and volatile organic compounds (VOCs).² BEVs would remove all tailpipe emissions and PHEVs (while not yet certified by the EPA as an ozone reduction measure) should result in fewer tailpipe emissions.

¹ Please see Attachment B for assumptions underlying these estimated benefits.

² Emissions from electrical generation would occur upstream.

2. OPTION 1: Develop a PEV Development and Infrastructure Working Group

Due to the diverse set of stakeholders necessary and the wide range of issues involved to adequately prepare for the widespread adoption of PEVs, a working group of relevant stakeholders could be established. While not an exhaustive list, the following stakeholders should have a role to play in such a group: local government officials, fleet managers, utilities, auto dealers, vehicle manufacturers, private businesses, advocacy groups already working in the field, air quality management organizations, state transportation agencies and regional planning groups (MPOs, COGs). This group will be able to provide recommendations on how to best support the adoption of PEVs in the region and can provide the basis for examining the other options presented in this report.

Some of the basic goals of the taskforce might include:

- Examining the permitting process for electric vehicle supply equipment (EVSE) to determine if it can be streamlined;
- Working with utilities to determine how they will be affected by increased power demand from PEVs;
- Public education on PEVs and EVSE;
- Examining possible incentives for PEVs and EVSE;
- Organizing for coordinated grant opportunities;
- Ensuring a positive customer experience with PEVs and EVSE.

To facilitate the taskforce's work, specific goals can be assigned to subgroups. For example, Kansas City has established a Plug-In Readiness Initiative to promote the adoption of PEVs and has created the following sub teams to address specific questions: Purchaser Confidence, Government Policy, Retail Demand, Charging Infrastructure, Vehicle Availability and Incentives.³ Decision makers might be aided in allocating limited resources if the taskforce produces a plan outlining the steps for the region to prepare for PEVs and EVSE, and identifying who should take specific actions.

For example, the cities of Eugene and Springfield, Oregon have worked with the University of Oregon to prepare an "Electric Vehicle Charging Station Infrastructure Community Needs Assessment." This report denotes the issues facing the area and recommends steps to address those issues over the next decade. The initial and highest priority action from this Assessment is for the formation of an EVSE/PEV working group. It may also be helpful for the taskforce or government to join a coalition promoting electrification such as the Rocky Mountain Institute's Project Get Ready or the

³ Metropolitan Energy Center. (2010). *Greater Kansas City Plug-In Readiness Initiative*. Retrieved from <http://www.kcenergy.org/pluginreadykc.aspx>

Department of Energy's Clean Cities program.

3. OPTIONS 2 and 3: Promotion of PEV Charging Infrastructure

Potential PEV owners with garages or carports with electric capacity can be expected to charge their vehicles at home. But would-be owners without access to a power source at home, or whose routine travel patterns approach or exceed the battery capacity of their PEV, will only purchase a PEV if they have access to a power source at work or at public charging stations. Each power source venue involves different policy issues and types of promotion.

Providing access to power at all three locations will be necessary to ensure a comprehensive charging system that serves all types of potential PEV drivers and optimizes the displacement of vehicle miles traveled powered by petroleum fuels. At this early stage of deployment, there is considerable uncertainty about the number and availability of public and private charging stations (beyond residential) that will optimize the penetration of PEVs. Most experts agree that home charging is the most critical factor in promoting PEV sales, especially for early adopters. Some experts contend that range anxiety concerns are overblown and public charging stations need not be as prevalent as some forecasts indicate.⁴ However, it is clear that access to public charging stations at diverse locations around large metropolitan areas will extend the range of operation of PEVs and allow owners to use their PEVs for trips to destinations that would otherwise not be accessible.

3.1 OPTION 2: Promote Home Based Charging

The majority of PEV charging is expected to take place at residences. In 2001, when gasoline was less than \$2 per gallon, a survey by the Electric Power Research Institute found that 63% of potential PEV owners would prefer charging their vehicles at home rather than going to a fueling station.⁵ A recent report by Pike Research estimated that 64% of all charging units in the United States will be installed in residences (partly due to the large number of single family homes in the United States⁶) and that 80% of PEV charging will take place at the owner's home.⁷

The same research indicates that potential PEV owners view public charging as a tertiary

⁴ Carney, D. (2010, March 4). *Electric Vehicle Range: What me worry?* Retrieved from <http://www.msnbc.msn.com/id/35352973/ns/business-autos/>

⁵ Sanna, L. (2005). *Driving the Solution: The Plug-In Hybrid Vehicle*. Retrieved from http://mydocs.epri.com/docs/CorporateDocuments/EPRI_Journal/2005-Fall/1012885_PHEV.pdf

⁶ Pike Research. (2010, September 22). *64 Percent of Electric Vehicle Charge Points in the United States to be Residential Units*. Retrieved from <http://www.pikeresearch.com/newsroom/64-percent-of-electric-vehicle-charge-points-in-the-united-states-to-be-residential-units>

⁷ Motovalli, J. (2010, October 12). Bringing Home Baby, Your Electric Car. *New York Times*. Retrieved from http://www.nytimes.com/2010/10/14/automobiles/autospecial2/14CHARGE.html?_r=1

priority behind home and workplace charging. This research matches the early focus of some municipalities already working to provide infrastructure. For example, the City of London, England is primarily focusing on encouraging home based charging installations, followed by workplace charging and finally public charging.

Many PEV owners will want to charge their vehicle with Level 2 charging (240 volts) because of the shorter recharging times. To fully charge a Nissan Leaf would require 22 hours at Level 1 (120 volts) and 8 hours at Level 2. For a Chevy Volt, full charging would take 10-13 hours for Level 1 and 4 hours at Level 2. Because an average day of driving will not fully deplete larger batteries, recharging times will usually be shorter than those noted above and may make using Level 1 charging feasible for many PEV owners. While owners of PHEVs with smaller batteries should be able to charge their vehicles overnight using existing electrical infrastructure (Level 1), owners of larger battery PHEVs and BEVs may need to upgrade their electrical systems to allow for reasonable recharging times depending on how far they drive on an average day. However most residential garages are not supplied with 240 volt service and the cost of upgrading may deter homeowners from installing this level of charging.⁸

The cost of installing Level 2 EVSE in a home will vary considerably based on each house's characteristics, with an average upgrade costing approximately \$2,000.⁹ Some homes may already have the electrical capacity to install a Level 2 charger and would only need to purchase the actual charging equipment and have it installed. Other homes may need to upgrade their wiring and electrical panel to allow for a Level 2 charger. Rewiring can be significantly more expensive if walls or floors need to be remodeled to replace existing wiring. Installing a Level 2 charger may in some cases require the utility to update the electricity distribution system in the area to allow for increased demand. This upgrade may be paid for either by the homeowner or it may be recovered by the utility through rates.

Because large numbers of PEV owners may want to charge their vehicles at home using Level 2 EVSE, it is important to streamline the process for homeowners to upgrade their electrical system for faster charging. Each municipality should review its current procedures for permitting for this type of electrical upgrade as there may not be an explicit policy for EVSE upgrades. The Society of Automotive Engineers (SAE) has set standards that ensure that all plug-in electric vehicles will be compatible with all

⁸ Pike Research. (2010). *Electric Vehicle Consumer Survey*. Retrieved from <https://www.pikeresearch.com/wordpress/wp-content/uploads/2010/11/EVCS-10-Executive-Summary.pdf>

⁹ U.S. Department of Energy. (2008, November). *Plug-In Hybrid Electric Vehicle Testing Activity*. Retrieved from <http://avt.inel.gov/pdf/phev/phevInfrastructureReport08.pdf>;
Electric Transportation Engineering Corporation. (2010, March). *Electric Vehicle Charging Guidelines for the Central Puget Sound Area*. Retrieved from http://www.psrc.org/assets/3756/eTec_Guidelines_3-24-2010_v2-0.pdf;
Electrification Coalition. (2009, November). *Electrification Roadmap*. Retrieved from <http://www.electrificationcoalition.org/electrification-roadmap.php>

charging stations. Currently, standards have been set for Level 1 and Level 2 charging and SAE is currently working on standards for higher voltage charging.¹⁰

A goal is that PEV owners wishing to upgrade their electrical system are provided with a clear idea of what to expect in this process (ideally prior to purchasing and bringing home a vehicle), including the need for a permit, the use of trained and/or certified installers, the expected cost of installation, and relevant safety concerns. The City of Raleigh, NC revised its permitting process for obtaining a recharger so that obtaining a permit would take one hour rather than three days.¹¹ The city has also set up a website that outlines the steps in having EVSE installed, permitted and inspected and an idea of how long each step will take.¹²

Friends of the Earth conducted a survey of the Bay Area in California to determine what the current permitting processes were across various jurisdictions and to provide suggestions for how the process could be streamlined.¹³ Recommendations from the report include:

- Adopting a specific permitting policy for EVSE and ensuring that staff members handling the permitting process are well trained and knowledgeable about the process.
- Creating websites with basic information on the steps of the permitting process along with more detailed guides so that consumers have easy access to all the information they need prior to beginning the process.
- Coordinating permitting processes across the region.
- Reducing the number of government office and home visits.
- Allowing for basic installations without upgrades to be self certified by electricians.

The City of San Francisco's Department of Building Inspection (DBI) has streamlined their residential permitting process to provide same day over-the-counter permits for qualified electricians and allows registered electricians to use instant, online

¹⁰ SAE International. (2010, January 15). *SAE Standard on EV charging connector approved*. Retrieved from <http://www.sae.org/mags/aei/7479>

¹¹ Murawski, J. (2010, July 12). *Raleigh rolls out speedy permits for electric car recharging*. Retrieved from <http://blogs.newsobserver.com/business/raleigh-rolls-out-speedy-permits-for-electric-car-recharging>

¹² City of Raleigh. (2011, February 9). *Electric Vehicle Charging Station Installation*. Retrieved from <http://www.raleighnc.gov/search/content/CityMgrDevServices/Articles/HowToElectricVehicleCharging.html>

¹³ Friends of the Earth. (2010, February 26). *A Survey of Bay Area Permitting Procedures for Electric Vehicle Charging Infrastructure*. Retrieved from http://www.foe.org/sites/default/files/Friends%20of%20the%20Earth_EV%20Charger%20Permitting%20Report_FINAL%20_5_.pdf

permitting.¹⁴ Once the customer has decided to purchase and install EVSE and has accepted the electrician's installation quote, the electrician does most of the leg work including obtaining the permit, completing the installation and coordinating an inspection with DBI. The City also recommends, that before installation, the electricity service provider is contacted to review load capacity and so the customer can be informed of special rates for EVs.¹⁵ The City is also offering training for permitting and inspection officials so that they will be aware of new issues raised by EVSE.

The state of Oregon's Department of Consumer and Business Services' Building Codes Division has incorporated EVSE installations of up to 30 amps¹⁶ at 240 volts into their minor labeling permit system. This allows electrical contractors to obtain permits at approximately one tenth of the cost and requires inspections for only 10% of installations. Several jurisdictions across Oregon, including Portland, have adopted the state's minor label system.¹⁷

Mitsubishi recently announced a collaboration with Best Buy and Eaton (a provider of EVSE) to streamline the process for those interested in installing Level 2 charging in their homes. Homeowners would have Best Buy's Geek Squad staff to evaluate each homes existing electrical system and manage installation of and permitting for charging equipment.

3.2 Additional Options to Promote Home Based Charging

Austin Energy in Texas is providing a cash rebate of \$1,500 to residential customers who have installed a Level 2 charging station at their home.¹⁸ The rebate is a part of the utility's regular budget and requires that the customers already own a PEV and have installed their charging station.

Forward thinking municipalities could even require new construction projects to include conduit installed to allow for future EVSE installation, thereby reducing the future need for concrete removal and/or retrenching from the electrical supply to the vehicle parking area.

There are many examples of this type of policy. Marin County, California requires that all

¹⁴ San Francisco Department of the Environment. (2010, October). *San Francisco Electric Vehicle Program Summary*. Retrieved from

http://www.sfenvironment.com/downloads/library/sf_ev_summary_october_2010.pdf

¹⁵ Interview with Mari Hunter of the San Francisco Department of Environment, (2010, November 16).

¹⁶ The Oregon Building Code Department is considering allowing installations up to 40 amps to use the minor label system

¹⁷ City of Portland. *Electric Vehicles the Portland Way*. Retrieved from

<http://www.portlandonline.com/shared/cfm/image.cfm?id=309915>

¹⁸ Austin Energy. (2011). *Plug-In Partners*. Retrieved from

<http://www.austinenergy.com/About%20Us/Environmental%20Initiatives/plug-in%20Partners/index.htm>

new residential development and commercial developments over 5,000 square feet install conduit that allows for future installation of solar PV.¹⁹ The state of Colorado requires homebuilders offer the option of pre-wiring for solar PV to the prospective buyer of the home.²⁰ The city of Vancouver, British Columbia requires all new single family homes to have a dedicated electric vehicle plug in outlet.²¹

3.3 Residential Charging for Apartment and Condo Owners

Providing charging infrastructure for PEV owners in multi-family units is a challenge that is only beginning to be addressed and there is not a clear model to address this demand. In a similar manner that businesses could provide at work charging as a benefit to employees, managers of apartments or condominiums could offer charging infrastructure at a certain number of parking spaces as a service to current residents or as an incentive to attract new residents that already own or are thinking about purchasing PEVs.

As an example, private companies could provide EVSE at multi-family units with the same business model as would be used for public charging infrastructure. The EVSE would be available to the public but residents of the apartment complex or condo would have the convenience of being able to charge their vehicles at night.

The city of Vancouver, British Columbia requires that all new multi-family buildings provide charging infrastructure for 20% of parking spaces. Under the City's building code, breaker rooms are also required to leave additional space for additional electrical panels in the future.²²

One incentive to encourage the installation of charging infrastructure is that buildings can receive points toward green building certification by LEED by adding EVSE to new or existing buildings.

3.4 OPTION 3: Promote Public Charging

As municipalities have limited resources with which to provide early EVSE, it is important that the supplied EVSE is put to its most effective use by determining where it

¹⁹ County of Marin. (2010, December 22). *Green Building Standards for Compliance*. Retrieved from http://www.co.marin.ca.us/depts/CD/main/comdev/advance/sustainability/greenbuilding/gbs/pdf/GB_R eq.pdf

²⁰ Colorado State Legislature. (2009). *House Bill 09-1149*. Retrieved from http://www.leg.state.co.us/clics/clics2009a/csl.nsf/fsbillcont3/56DAD78B9D26BD5187257539006E7FF9?open&file=1149_enr.pdf

²¹ City of Vancouver. (2008). *City of Vancouver is Going Electric*. http://vancouver.ca/sustainability/electric_vehicles.htm

²² City of Vancouver. (2008). *Electric Vehicle Infrastructure Requirements for Multi-Family Buildings*. Retrieved from <http://vancouver.ca/sustainability/EVcharging.htm>

will be most used. A first step in this process is creating profiles of who in the municipality is likely to be an early adopter of PEVs and determining the probable locations of where they live and work. If most early adopters are expected to be able to charge their vehicles at their residences, significant public charging infrastructure may not be necessary to support them.

One method for forecasting potential PEV purchasers is to examine purchase patterns of hybrid vehicles in the community. The Puget Sound Regional Council (PSRC) found that there was a strong correspondence between hybrid ownership and those who pre-registered for the Nissan Leaf.²³ If data can be obtained that provides a breakdown of hybrid purchases by zip code this can provide an idea of which zip codes would likely be areas with high numbers of early adopters. For example, in the Eugene-Springfield assessment, hybrid registration by zip code was obtained from the Oregon Department of Transportation. Then education and income level were taken for the metropolitan statistical area from the U.S. Census by census block. By overlaying hybrid purchases and income and education levels a municipality can see if there is an overlap between the two groups.²⁴

If these data are unavailable, a profile of hybrid purchasers can be created by building on surveys providing general information on hybrid purchasers. Surveys have shown that hybrid owners tend to be older (50 rather than 40), wealthier (incomes above \$100,000) and have a higher level of education than the average automobile purchaser.²⁵ Data from the U.S. Census can then be used to determine which census blocks in the area have high percentages of residents matching those variables.

The City of London, England has also developed a methodology to determine who would likely be early adopters of PEVs. Based on households registering for alternative fuel discounts, the City was able to determine where current hybrid and PEV owners live. It was noted that the areas with higher ownership rates corresponded to those municipalities offering incentives such as free or discounted parking or charging infrastructure, but that the attitude of residents in the area was also considered a driver of alternative vehicle adoption.

The City then categorized the socio-economic data of these early adopters by sixty-one household types using over 400 variables and determined that most hybrid or PEV owners fell into the following five (of the 61) household types:

- 1) "Affluent middle aged singles living in Central London;
- 2) professionals living in middle ring suburbs and working in central London;

²³ Puget Sound Regional Council. (2010, July). *Electric Vehicle Infrastructure: Regional Station Siting Analysis*. Retrieved from http://www.psrc.org/assets/4144/Station_siting_July2010.pdf

²⁴ Interview with Bob Parker of the University of Oregon. (2010, November 19).

²⁵ Hybrid Cars. (2006, March 31). *Profile of Hybrid Drivers*. Retrieved from <http://www.hybridcars.com/hybrid-drivers/profile-of-hybrid-drivers.html>

- 3) ambitious singles or couples living in high density suburbs;
- 4) young and single skilled workers living in inner suburbs;
- 5) business managers living in detached houses in outer suburbs".²⁶

The entire City of London was then screened to see where the highest concentration of these five household types resided. Additional variables that were weighed included: availability of off-street parking, owning more than one vehicle and a daily driving range between ten and fifty miles. Once an area has determined who likely PEV early adopters are, where they live and their expected driving patterns, a plan for providing public PEV charging can be developed.

Variables that municipalities should consider in planning for public charging infrastructure include:

- Does the city have priority planning areas where it is trying to focus new development?
- Are most of the identified early adopters able to charge at home, therefore not requiring significant public charging infrastructure for their use?
- What are the areas of high housing and employment density that would allow EVSE to be accessible to the greatest number of people?
- Are there businesses to partner with who would share in paying for the EVSE?

The city of San Francisco, CA is establishing a network of public chargers throughout the city at city owned garages and parking areas during the first phase of installations to speed the installation process.

The City of Eugene, OR conducted a survey of residents to determine where EVSE installations are most desired. Based on the survey results, thirteen high priority points were identified and the best areas to place the EVSE within a quarter-mile radius of the points were determined.

Factors influencing charging station placement include:

- Is the capacity of the electric grid sufficient to handle the added load from charging without requiring upgrades?
- Can the current or planned construction or renovation projects in the area accommodate conduit and EVSE to be set up without retrofitting the existing construction?
- Are businesses in the area willing to host charging stations?

²⁶ Greater London Authority. (2009, December). *London's Electric Vehicle Infrastructure Strategy*. Retrieved from <https://www.sourcelondon.net/sites/default/files/draft%20Electric%20Vehicle%20Infrastructure%20Strategy.pdf>

Several municipalities stated negotiations are underway with businesses who are interested in having the charging infrastructure installed in their parking areas.

It is important to involve relevant stakeholders in public EVSE placement decisions. This would ideally flow from a working group on an EVSE working group, including utilities, adjacent businesses owners, landowners of the potential sites and the municipality.²⁷

3.5 Costs and Payment for Public Charging

Like home charging, the costs of installing public charging will vary considerably depending on the variables at each potential site. Some buildings or parking areas will not require upgrades of their voltage, wiring layout or electrical panel sizing if sufficient capacity is available. If existing concrete must be removed and replaced to allow for new or upgraded wiring, the costs of installation will increase significantly. The same issues discussed for home installations are relevant for potential public locations, including utility upgrades to the distribution network due to increased electrical demand. Due to these variables, a Level 2 charging installation may cost anywhere between \$2,000 and \$9,000 per charger.²⁸

Similar considerations apply to faster charging station locations and the local utility will almost certainly be involved due to the high voltages required. Costs for fast charging stations could range between \$25,000 and \$70,000.²⁹

Determining how payment will be processed at public charging stations is another issue under consideration by municipalities and their partners. In San Francisco, the city owned public charging stations will initially provide free charging for an undetermined period of time, but the charging units will be equipped if and when payment is required in the future.³⁰ GE conducted research showing that charging stations that would stations which accept credit/debit cards were the preferred system of payment.

Businesses that provide an EVSE location may feel that the economic benefits of

²⁷ Interview with Dave Mayfield of ECOtality. (2010).

²⁸ U.S. Department of Energy. (2008, November). *Plug-In Hybrid Electric Vehicle Testing Activity*. Retrieved from <http://avt.inel.gov/pdf/phev/phevInfrastructureReport08.pdf>; Electric Transportation Engineering Corporation. (2010, March). *Electric Vehicle Charging Guidelines for the Central Puget Sound Area*. Retrieved from http://www.psrc.org/assets/3756/eTec_Guidelines_3-24-2010_v2-0.pdf;

Electrification Coalition. (2009, November). *Electrification Roadmap*. Retrieved from <http://www.electrificationcoalition.org/electrification-roadmap.php>

²⁹ Electrification Coalition. (2009, November). *Electrification Roadmap*. Retrieved from <http://www.electrificationcoalition.org/electrification-roadmap.php>; Electric Transportation Engineering Corporation. (2010, March). *Electric Vehicle Charging Guidelines for the Central Puget Sound Area*. Retrieved from http://www.psrc.org/assets/3756/eTec_Guidelines_3-24-2010_v2-0.pdf

³⁰ Interview with Mari Hunter of the San Francisco Department of Environment, (2010, November 16).

attracting and retaining customers are more beneficial than charging for the use of the EVSE. Project Get Ready analyzed the investment potential of public charging stations in a 2009 report providing tools for businesses interested in examining the costs and benefits of installing EVSE.³¹

There is one major hurdle to requiring payment for use of a public, electric charging station – the supply and/or delivery of electricity may be mandated to occur through the local utility. One alternative is to charge for the parking space rather than the electricity. A second option, which has many potential roadblocks, includes petitioning the state utility commission to allow third party sale of electricity for PEVs. As noted in the following section, working with the local electric utility to provide this type of service may be the most beneficial method and lead to additional benefits for other collaboration.

³¹ May, J. and Mattila, M. (2009, May). *Plugging In: A Stakeholder Investment Guide for Public Electric-Vehicle Charging Infrastructure*. Retrieved from <http://projectgetready.com/resources/infrastructure/plugging-in-a-stakeholder-investment-guide-for-public-electric-vehicle-charging-infrastructure>

4. OPTION 4: Work With Utilities

As providers of the power for PEVs, utilities will play a key role in ensuring a smooth transition as electric vehicles begin to arrive on the market in large numbers.

As public and private EVSE is installed, it is important that the utility is aware of where installations are planned to ensure local systems are able to handle the additional load requirements.

One method of providing this type of information to utilities is an opt out system where customers who are either purchasing a PEV or arranging to install EVSE would automatically pass along their information to the local utility unless they chose to opt out. This would give utilities an idea of where new EVSE might put strains on the existing distribution system. Utilities that have smart or time-of-use meters can use this technology to monitor aggregate loads and see which transformers might need upgrading due to increased load.

It is important that the charging of electric vehicles does not require increased capacity from utilities. Ideally, charging will take place in the late evening and early morning when utilities generally have the most unused capacity. Some utilities are currently working to install time-of-use or smart meters and to develop different pricing plans for PEV customers to encourage off-peak charging practices.

For example, Southern California Edison (SCE) offers two PEV rate plans. The first uses one time-of-use meter for the whole house and offers varying rates depending on the time of day. During “super off-peak” periods, midnight to 6 am, the charge per kWh is \$0.10, but during on-peak hours, 10 am to 6 pm, the charge is \$0.19 per kWh. The other PEV plan offered by SCE involves the installation of a separate meter (supplied free by SCE) used exclusively to monitor electricity usage from the PEV. On-peak (noon to 9 pm) electricity rates for vehicle charging are \$0.27 per kWh, while off-peak rates (all other hours) are \$0.11 per kWh.

Pacific Gas and Electric also offers similar plans to customers with PEVs through its E-9 rate plans which can meter either the entire house (Rate A) or only the PEV (Rate B). During the summer, Rate A off-peak (midnight to 7 am) charges are \$0.05 per kWh, partial-peak (7 am to 2 pm and 9 pm to midnight) are \$0.104 per kWh and peak (2 pm to 9 pm) charges are \$0.284 per kWh. For Rate B, the off-peak rate is \$0.056 per kWh, partial-peak is \$0.10 and peak is \$0.28 per kWh. During the winter there are no peak rate charges.³² Cities and counties can urge their electricity provider and utility commission to establish such tariffs, if they do not already exist.

Vehicles and EVSE may also incorporate ‘smart’ technology that is able to control when

³² Pacific Gas and Electric Company. (2011). *Electric Vehicle Charging Rate and Economics*. Retrieved from <http://www.pge.com/about/environment/pge/electricvehicles/fuelrates/index.shtml>

a vehicle is charged, based on electricity rates and/or demand for electricity on the local grid. Utilities are beginning to educate their customers on the reasons for varying rates and the importance of charging during off-peak hours.

5. OPTION 5: Educate the Public

Ensuring realistic consumer expectations about electric vehicle performance and recharging infrastructure requirements will be critical in the first few years of PEV adoption. Public education about PEVs may also encourage higher rates of adoption as more knowledge about PEVs appears to correlate with intent to purchase a PEV.³³ PEV manufacturers are a prime source of information for consumers through commercials and advertisements. Many utilities such as Pacific Gas and Electric³⁴, Austin Energy³⁵ and Southern California Edison³⁶ are already providing information to consumers through their websites.

Cities and counties can also play a similar role. The Rocky Mountain Institute's Project Get Ready identified Raleigh as a top city for education outreach citing its development of a guidebook for training professionals in EVSE and a coordinated training program for electrical contractors. The city also provides information to the general public via websites and newspaper articles.³⁷

³³ Community Planning Workshop. (2010, November). *Draft of Electric Vehicle Charging Station Infrastructure Community Needs Assessment*.

³⁴ Pacific Gas and Electric Company. (2011). *Plug-In Electric Vehicle (PEV) Basics*. Retrieved from <http://www.pge.com/myhome/environment/pge/cleanair/electricdrivevehicles/pevbasics/index.shtml>

³⁵ Austin Energy. (2011). *Plug-In Partners*. Retrieved from <http://www.austinenergy.com/About%20Us/Environmental%20Initiatives/plug-in%20Partners/index.htm>

³⁶ Southern California Edison. (2011). *Plug-In Electric Vehicles*. Retrieved from <http://sce.com/PowerandEnvironment/PEV/overview.htm>

³⁷ Roland Berger Strategy Consultants. (2010). *PEV Readiness Study*. Retrieved from http://www.rolandberger.com/expertise/publications/2010-10-14-rbsc-pub-PEV_Readiness_Study_Electric_Vehicles_in_America.html

6. OPTION 6: Provide Incentives

While the federal and some state governments offer incentives for electric vehicle infrastructure, local governments can also provide incentives to those interested in installing EVSE or purchasing PEVs. Below are listed the types of incentives currently offered by local governments across the country:

- Discount or pass on vehicle emission or registration requirements;
- Preferred/Free Parking at airport (LAX); SFO offers free charging and free parking;
- Special access to HOV/carpool lanes/HOT;
- Infrastructure grant or credit.

6.1 Costs

The costs incurred by local governments will vary considerably depending on what role they intend to play in the provision of infrastructure. Estimates of the cost of installing publically available Level 2 EVSE vary considerably depending on the characteristics of the installation. Installations done in concert with new construction or renovations may be the least expensive method as they will require no retrofitting or trenching to supply the required electrical infrastructure. One strategy that municipalities can adopt to reduce costs of future installations is to require all new construction or retrofit projects to incorporate conduit to allow for future EVSE installations. This requirement could be put in place for all municipal government construction projects or extended to all public and private construction projects. New building owners or tenants could also be given the option of installing conduit during the construction process in anticipation of future EVSE infrastructure.

There are several different models for providing public EVSE ranging from installation by the municipality to having a private business install the infrastructure. For example, San Francisco owns the charging stations and the land they are sited (generally city owned parking garages) and has contracted with Coulomb to manage and maintain the public chargers for the first three years. Other cities such, such as Houston, TX, are working with companies like NRG Energy to establish privately funded charging infrastructure throughout the city. Many cities are working with ECOtality and Coulomb which have received grants from the federal government to provide charging infrastructure for selected cities across the United States. The U.S. Department of Energy has proposed a competitive grant program that will allow municipalities to seek up to \$10 million to promote 'regulatory streamlining, infrastructure investments, vehicle fleet conversions, deployment of EV incentives (e.g., parking, HOV access) partnerships with major

employers/retailers, and workforce training.³⁸

³⁸ U.S. Department of Energy. (2011, January 26). *Vice-President Biden Announces Plan to Put One Million Advanced Technology Vehicles on the Road by 2015*. Retrieved from <http://www.energy.gov/news/10034.htm>

7. Conclusion

The six options discussed in this document provide cities and municipalities a good outline of the necessary steps required to begin preparation for the arrival of plug-in electric vehicles. Due to the rapid expansion of this technology, it is important that municipalities take advantage of knowledge obtained by consulting or networking with their peers who have already considered similar endeavors. Many cities with experience with the provision and development of electric vehicle charging infrastructure have been highlighted in this document.

One of the more important steps in this development is to form a working group of stakeholders to provide a forum to address issues raised by implementing EVSE. The regulation and promotion of home-based charging stations is expected to occur in these early years of electric vehicle acceptance. Additional policies to address the provision of public and workplace charging stations should also be considered. To better target provision of EVSE, studies and analyses should be conducted to predict the location of early adopters of electric vehicles and where potential home-based charging stations may be requested. As the providers of power for PEVs, utilities are major stakeholders and will play an important role in promotion of PEVs and EVSE. They will also be a vital partner in the education of the public about the potential of PEVs and how EVSE will work. Municipalities should also consider if incentives should be offered to assist in the adoption of electric vehicles and private supply equipment.

Attachment A: List of Planned PEV Releases in US Market

Make/Model	Vehicle Type	Battery Size (kWh)	Electric Range (miles)	Target Intro in US	Estimated Price
Audi A1 Sportback	PHEV	20		2011	
BMW ActiveE	EV	125	100	Field trial in 2011	
BYD E6	EV	75-200	Up to 200	2010	
BYD F3DM	PHEV		60	2010	\$22,000
Coda Sedan	EV		90-130	Late 2011	\$45,000
Daimler Smart ED	EV		90+	2012	
Fisker Karma	PHEV	20	50	2011	\$87,900
Ford Escape	PHEV	10	40	2012	
Ford Focus	EV		100	2011	
Chevy Volt	PHEV	16	40		\$41,000
Hyundai Blue Will	PHEV		38	2012	
Hyundai i10	EV		100	2012	
Mitsubishi iMiEV	EV	16	70-100	2011-2012	\$30,000
Fiat Micro-Vett e500	EV		75	2012	
Nissan Leaf	EV	24	73	2010 (limited)	\$32,780
Smart Fortwo	EV		63	2012	
Tesla Model S	EV		160-300	2012	\$57,400
Tesla Roadster	EV		245	2010	\$109,000
Think City	EV		100	2011	
Toyota Prius	PHEV		10-18	2012	\$27,000-\$34,000
Volkswagen Twin Drive	PHEV		30	2013	
Volvo V70	PHEV		31	2012	
Wheego Whip LiFe	EV		100	2011	

Attachment B: Assumptions Underlying PEV Benefits

Average vehicle travels 11,000 miles annually

Efficiency of new gasoline powered car: 25.8 mpg

Efficiency of electric powered vehicle: 0.35 kWh per mile

Efficiency of PHEV gasoline engine: 37 mpg

Cost of electricity: \$0.116 per kWh

Cost of gasoline: \$3 per gallon

Electricity emission rate: 1.3 pounds of CO₂ per kWh

A PHEV 10 will travel 23% of miles on battery

A PHEV 40 will travel 62% of miles on battery