October 13, 2010

October 13, 2010

Virginia Clean Cities
701 Carrier Drive, MSC 4115
Harrisonburg, VA 22807
(540) 568-8896 phone
(540) 568-5181 fax
info@hrccc.org
http://www.hrccc.org

November 9, 2010 version – includes minor typographical update

Table of Contents

Executive Summary

Commercially produced electric vehicles (EV) are a reality in Virginia today, and Virginia is well-positioned physically and economically to be a leader in electric vehicles. Embracing electric vehicle use in Virginia will assist statewide efforts to reduce vehicle emissions, increase energy independence, and generate positive economic development for the Commonwealth. This initial Virginia "electrification plan"…

- details how to overcome potential barriers associated with the adoption of plug-in vehicles and charging infrastructure specifically related to codes, standards and processes;
- outlines initial communication strategies to educate appropriate partners, stakeholders and the general public;
- illustrates the existing and potential incentives to encourage businesses and individuals to purchase plug-in vehicles; and
- outlines the issues and tasks necessary to the installation of charging infrastructure, from the technical to the managerial.

Virginia's codes and standards are in a good position. This plan identifies best practices, including online access to information and rapid permitting processes enacted by some Virginia localities. Nothing in the statewide building code prevents or delays charger installations.

The reality of charging infrastructure, technical and managerial, is outlined at length in this document. The process of charging an electric vehicle can be as simple as plugging the vehicle into a 120 volt outlet; however, for faster charging, electrical upgrades may be needed.

The Virginia EV educational process will involve many partners, including regional and statewide organizations, Clean Cities, and the Commonwealth's varied university and community college system. This plan outlines some initial educational strategies and processes and provides some base resources. Additional information can be found online at this centralized Virginia Electric Vehicle website: http://www.VirginiaEV.org/.

Several incentives have been identified that can accelerate electric vehicle adoption and position Virginia for advanced adoption of these vehicles. In addition to nonmonetary incentives, the addition of a $2,000 Virginia tax credit for electric vehicle purchase can put us in a competitive position with Maryland and other states offering such an incentive.

Additional policy suggestions and implications are included in the recommendations section.

In tracked alternate fuel vehicle fleets alone, there are 71 plug-in-hybrid or full electric vehicles on Virginia's roads today. These are generally converted vehicles, light duty small trucks, and neighborhood electric vehicles. The upcoming months bring initial

deployments and sales of full sized electric vehicles from several major automotive manufacturers, as well as additional offerings from niche producers.

These vehicles represent an attractive alternative to traditional vehicles powered by petroleum fuels. With lower fuel and operational costs as well as zero tailpipe emissions, electric vehicles can lead to cleaner air in our urban areas as well as allow us to use robust in-state coal and nuclear energy and allow for renewable fuel options such as solar, wind and biomass power.

In these challenging economic times, electric vehicles represent an economic opportunity for the Commonwealth. In addition to the strong penetration of existing energy jobs that exist throughout the state, in 2010, 84 new jobs and $23.5 million in new investment have been announced in the electric vehicle charger and battery component sectors in Virginia. With Virginia's excellent business environment, the electric vehicle business sector can continue to grow and flourish with existing Virginia businesses. PRTM Management Consultants, an energy industry research group, has estimated that vehicle electrification could represent greater than $250 billion in economic development opportunities worldwide by 2020, taking into account growth in electricity generation and distribution, grid and infrastructure investments, batteries and other components, sales of vehicles, and associated advertising and marketing services. PRTM's research also suggests that government and commercial fleets will be a leading sector for early adoption of electric vehicles.

Virginia's economy is already benefitting from the electric vehicle value chain. Companies located in Virginia currently make batteries, battery components, motors, and charging stations. They design vehicles, deploy electric vehicles, and convert vehicles to plug-in hybrids and battery electric vehicles. Northern Virginia is connected within the 70-mile radius of the federally funded DC ChargePoint America charger deployment, and the Commonwealth is home to many early adoption electric vehicle enthusiasts. In central Virginia, Charlottesville is involved in a significant smart grid demonstration program and a vehicle conversion deployment program and joins Northern Virginia with a high number of early hybrid vehicle owners. Richmond has a large fleet presence and a local electric vehicle initiative. The Hampton Roads region includes large federal fleets in close proximity that are likely to benefit from enhanced vehicle electrification. Virginia fleets currently have numerous electric vehicles and there are several public and private charging stations available, including modern units and deployment units from the late 1990's.

Virginia utilities have installed plugs into converted Prius vehicles, deployed plug-in bucket trucks, and have agreed to purchase and test Chevy Volt units when available. The Commonwealth has installed free access vehicle charging units at one rest area and hosts numerous electric vehicles in agency and university fleets. Virginia entities are researching vehicle conversions, assessing charging capacity, reviewing financial strategy, and considering roles in jump-starting vehicle adoption and infrastructure deployment to further benefit of our local economy.

Providing both financial and environmental benefits, vehicle electrification in Virginia can help state and local fleets comply with current and future clean air regulations. Vehicle electrification will be especially beneficial in Hampton Roads, Richmond, and Northern Virginia localities currently facing air attainment and health issues now and in the future.

In summary, Virginia is well-positioned for the arrival of electric vehicles and is making additional strides to embrace and expedite their adoption. Taking an active role in the promotion of electric vehicles at this crucial period of growth will allow the Commonwealth to secure the economic development opportunities that may otherwise flow to other regions.

Background

The Virginia Get Ready Roundtable met initially on May 18, 2010. Following this opening discussion, more than 100 electric vehicle stakeholders continued to plan for upcoming electric vehicles with the support of the Commonwealth of Virginia and Dominion Virginia Power. Virginia Clean Cities served as coordinator for this effort. Leveraging the national Project Get Ready initiative, the group met and discussed efforts throughout 2010 to establish this cooperative plan for the deployment of electric vehicles in Virginia based on the national Project Get Ready initiative.

Project Get Ready (PGR) is an initiative led by the Rocky Mountain Institute to focus on identifying barriers and proposing solutions related to adoption and deployment of electric vehicles. The national PGR effort provides a robust forum to interact with other electric readiness partner cities and technical advisors to address a range of issues. For information on the Rocky Mountain Institute and Project Get Ready, visit http://projectgetready.com/.

The Virginia vehicle electrification effort remains open to all interested parties. Participating stakeholders in the readiness plan included state and local government entities, fleets, universities, utilities, civic organizations, vehicle manufacturers, and related businesses. A partial list of organizations appears below:

Commonwealth of Virginia and Federal Government Entities:

- Department of General Services
- Department of Housing and Community Development
- Department of Mines, Minerals and Energy
- Department of Motor Vehicles
- Department of Transportation
- Secretary of Transportation
- Virginia Economic Development Partnership
- Virginia Motor Vehicle Dealer Board
- United States Department of Energy and its Clean Cities program

Regional Virginia Government Entities:

- Albemarle County
- Arlington County
- Chesterfield County
- City of Richmond
- Fairfax County
- Henrico County
- Loudoun County

Virginia Universities and Colleges:

- J. Sargeant Reynolds Community College
- James Madison University
- University of Virginia
- Virginia Commonwealth University

Public Utilities:

- Dominion Virginia Power
- Old Dominion Electric Cooperative

Civic Entities:

- Advanced Energy
- Electric Vehicle Association of Washington DC
- Southern Environmental Law Center
- Sustainable Transportation Initiative of Richmond
- Urban Grid Solar
- Virginia Automobile Association
- Virginia Clean Cities
- Virginia Municipal League
- Virginia Sierra Club

Businesses:

- Advanced Vehicle Research Center
- Aker Wade
- CarCharging
- Coulomb
- Encell
- Evatran
- Ford
- General Motors
- Kollmorgen
- Nissan
- Nova Charge
- Plugless Power
- Richmond Segway

- Smith Electric Vehicles
- Volkswagen
- Werres

A full listing of project partners with basic contact information is available in Appendix 8 to serve as a resource to new electric vehicle stakeholders.

The Virginia Get Ready: Electric Vehicle Plan was refined through workgroup efforts throughout 2010. The structure of the effort was based on the four working groups identified by the neighboring electric vehicle readiness initiative in Raleigh, North Carolina. The Virginia Get Ready Roundtable subcommittee groups included the following 4 groups:

1. Standards and Readiness
2. Education and Outreach
3. Incentives
4. Sites and Installation

A steering committee for the effort consisted of leaders from each of the workgroups as well as Virginia Clean Cities and the Commonwealth of Virginia's Deputy Secretary of Transportation.

Based on likely adoption predictions, concentrated infrastructure and vehicle efforts in this plan should be initially targeted for the specific regions of Northern Virginia, Charlottesville, Richmond, and Hampton Roads.

This effort was based on the following comprehensive initial goal: Establish Virginia as a leader in the adoption of the electric vehicles in order to reduce vehicle emissions, increase energy independence, and generate positive economic development opportunities for the Commonwealth. By October 2010, present an initial Virginia "electrification plan" detailing:

1. How to overcome potential barriers associated with the adoption of plug-in vehicles and charging infrastructure specifically related to codes, standards and processes;
2. A communication strategy to educate appropriate partners, stakeholders and the general public;
3. The potential incentives (monetary, nonmonetary, upfront and long-term) to encourage businesses and individuals to purchase plug-in vehicles;
4. The issues and tasks related to the installation of charging infrastructure, from the technical to the managerial.

The following barriers were identified:

- Not enough cars in the pipeline - Original Equipment Manufacturers (OEMs) need proof of consumer demand
- How can we manage this as a multi-sector, statewide project?
- How can we bring down upfront costs for consumers?
- Consumer hesitation at diving into a new paradigm for mobility (range, technology)

- Total Cost of Ownership (Initial costs versus long-term costs)
- Red tape around infrastructure installation
- What if these cars exacerbate state peak electric load?
- Who will pay for infrastructure?
- Consumers have limited understanding of plug-ins
- Who will service my plug-in?
- What are the public safety issues

The Commonwealth's Energy Policy Includes the Promotion of Electric Vehicles.

During his campaign, Governor McDonnell emphasized that transportation and innovative energy issues, including transportation fuel alternatives such as natural gas and electricity, would be a priority of his administration. In a June 16, 2010 press release discussing this electric vehicle collaboration, he stated:

> Electric cars will be an important means of transportation in the decades ahead, and they will play a role in helping to reduce our demand for foreign sources of energy…The easier we make it for electric cars to operate in the Commonwealth, the more we will encourage private citizens and businesses, and local governments and agencies to purchase these vehicles.

The Governor's emphasis on electric vehicles aligns with Virginia Code §67-102.A.8, which explicitly states that the policy of the Commonwealth shall "promote the use of motor vehicles that utilize alternate fuels and are highly energy efficient."

The 2010 Virginia Energy Plan points out that the transportation sector in Virginia uses 31% of the total energy in the Commonwealth, and that petroleum is the primary source of energy for transportation, providing 97% of transportation energy. Conventional internal combustion engine vehicles rely on gasoline, a petroleum-based fuel that largely originates from foreign sources. These conventional fuel vehicles create much greater carbon emissions than electric vehicles. Therefore, Virginia has a two-fold opportunity to benefit the region through the promotion of electric vehicles, both from an environmental and national security perspective. Electric vehicles will benefit the Commonwealth environmentally by providing transportation that creates much lower carbon emissions than conventional vehicles. Additionally, electricity in Virginia is largely fueled by domestic sources such as nuclear, coal, natural gas, and renewable sources; therefore, promoting electric vehicles reduces our dependence on foreign sources of petroleum for vehicle fuel and, in turn, strengthens our national security.

Virginia Get Ready Workgroup Efforts

The project operated with a ***Steering Committee*** that included all workgroup leads, Virginia Clean Cities, and the Governor's Deputy Secretary of Transportation. This Committee provided oversight and direction, determined major project deadlines, identified and assigned roles, and compiled information for the final work product and path

forward. Beyond this initial readiness effort, Virginia Clean Cities and the Commonwealth will continue to pursue these electric vehicle readiness activities as necessary.

Standards Readiness Working Group:

The group efforts were coordinated by Evatran, a Wytheville Virginia small business that manufactures plugless vehicle chargers. This working group addressed potential barriers associated with the installation of charging stations, specifically standards and processes related to codes, permitting, and inspections.

Education and Outreach Working Group:

This group was coordinated by the Electric Vehicle Association of Washington DC and James Madison University. The purpose of this working group was to manage the knowledge gained through this project and to disseminate it to appropriate partners, stakeholders and the general public. This group determines what to say, when, how and to who with the realization that a strong, accurate, and consistent message must be presented at all times (benefits, technology agnostic planning, codes, standards, incentives, etc.).

Incentives Working Group:

This group was coordinated by the Virginia Automobile Dealers Association and the Sustainable Transportation Initiative of Richmond (STIR). The working group addressed the means through which businesses and individuals can be encouraged to purchase plug-in vehicles, through monetary and non-monetary perks and incentives, both up-front and long-term.

Sites and Installation Working Group:

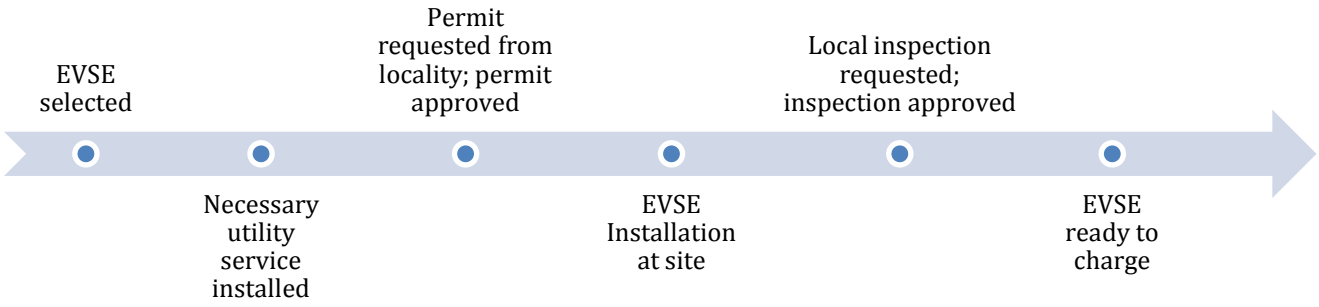
This workgroup was coordinated by Dominion Virginia Power. The group focused on the issues and tasks necessary to install charging stations – at public, private, and residential locations - from the technical to the managerial. This group also identified example costs for siting and installing charging stations under different scenarios.

Standards and Readiness

Virginia's initial deployment localities have varying but high levels of readiness for electric vehicle charger deployment. Many localities have already permitted chargers and are prepared for upcoming hardware. Some have advanced best practice procedures underway, such as online permit processes. Additionally, best practices such as Fairfax County's two hour permitting process, showcase an opportunity for rapid charger installations for other Virginia localities. Expedited and streamlined permitting process or standardization for charging station installation throughout Virginia will be helpful. Because the permitting process is handled through city and county offices, there may be as many as 140 different permit processes in the Commonwealth.

One example of a recent successful installation was the Center for Innovative Technology facility in Herndon, Virginia. This represented a learning opportunity for local permitting and installation as well as a chance to identify and address limitations with indemnification. The legal challenges were quickly resolved using language from the state code. The smooth installation of a free charger drew much interest from local electricians, who realized the market growth potential. The charger communicates with DOE through a software application. The grand opening for this charger will be held in the fall of 2010. The process for installing an electric vehicle recharging station can range from very complex to relatively easy based on the preparedness of the local governing bodies. The technical term for charging stations is electric vehicle supply equipment (EVSE). As complexities related to codes, permitting and inspection for EVSE installations could represent a barrier to electric vehicle adoption, a quick and easy process to install an EVSE is a requirement for widespread adoption of electric vehicles. Much momentum will be lost with a drawn-out and confusing installation process if a new EV-owner has to take multiple days off work for home EVSE installation and inspection or repeatedly contact different agencies for information and updates. Similarly, commercial projects can be held up for weeks or months while different agencies work to straighten out complex permitting requirements for the installation of a recharging station. Much work has been completed across the nation to prepare for electric vehicles by streamlining and simplifying these permitting processes. This information can be leveraged to assist Virginia localities in streamlining their own processes.

Installation of Level 1 EVSE can be as simple as a 120-volt outlet and does not require the steps listed here. For a description of different levels of charging, see the Sites and Installation section of this report. As discussed in that section, a traditional installation process for a Level 2 system requires the basic steps listed below:



While the above procedure seems relatively simple and straightforward, it has various levels of complexity for both residential and commercial installations, including:

- Type of permit required by the locality,
- Process for obtaining the permit (and expected approval timeframe),
- Site plans required,
- Site requirements and proximity of EVSE installation to the necessary electrical wiring,
- Inspection process (and expected approval timeframe),

- Number of and connectedness of parties involved with the process, and
- Education level of EV owners, electrical contractors, and local inspectors.

Across the United States, many groups are beginning to prepare for the coming fleet of electric vehicles. As discussed previously, these efforts are multi-faceted, but the vast majority of groups include plans to streamline the permitting and inspection process required for EVSE infrastructure. The Rocky Mountain Institute's "Project Get Ready" (PGR) is prepared to assist different localities and states with setting up plans and workgroups around getting ready for electric vehicles. Other PGR efforts have been leveraged here to understand how Virginia localities can review their own processes and determine areas for improvement.

The Virginia PGR Standards and Readiness team developed a questionnaire and flow chart to help Virginia localities examine different aspects of regulations, codes, and procedures related to the permitting and inspection processes that may affect installation of electric vehicle charging infrastructure. The goal here is to locate the process bottlenecks in order to reduce the time and complexity involved in the EVSE installation process.

The following recommendations related to Standards and Readiness are provided only as examples of steps that localities can undertake. We realize that actual implementation may be constrained by resource availability at each locality.

In order to streamline the process to install an EVSE or in some cases, create an EVSE installation process, attention must be paid to a number of key areas. By examining the answers to the questions below, a locality can determine the aspects of the installation process that cause the biggest bottlenecks or challenges to the expedited installation of an EVSE. Once identified, the locality can revise existing or develop new processes or goals to remedy these challenges based on available resources and manpower. In determining a permitting process, a locality should answer the following questions for both residential and commercial installations:

Overview Questions

- Is there currently a process that will cover EVSE installation or will a new process need to be developed?
- What agencies and parties are involved with the installation of an EVSE (electrical appliance category)?
- What is the education level of these parties on EVs and EVSE installation?
- Do different requirements exist between residential and commercial installations?
- What IT systems are in place to support the process and insure open communication between parties?

Permitting Questions

- What type of permit is currently required for the installation of an EVSE (electrical appliance category)?
- Who can request the permit?

- How can the permit be requested and how is it approved (over the counter, fax, online)?
- What is the typical time required from permit request to permit approval?
- What is the cost of the permit?

Electrical Plan Questions

- Is an electrical plan required for installations?
- What type of additional information is required regarding the installation?

Inspection Questions

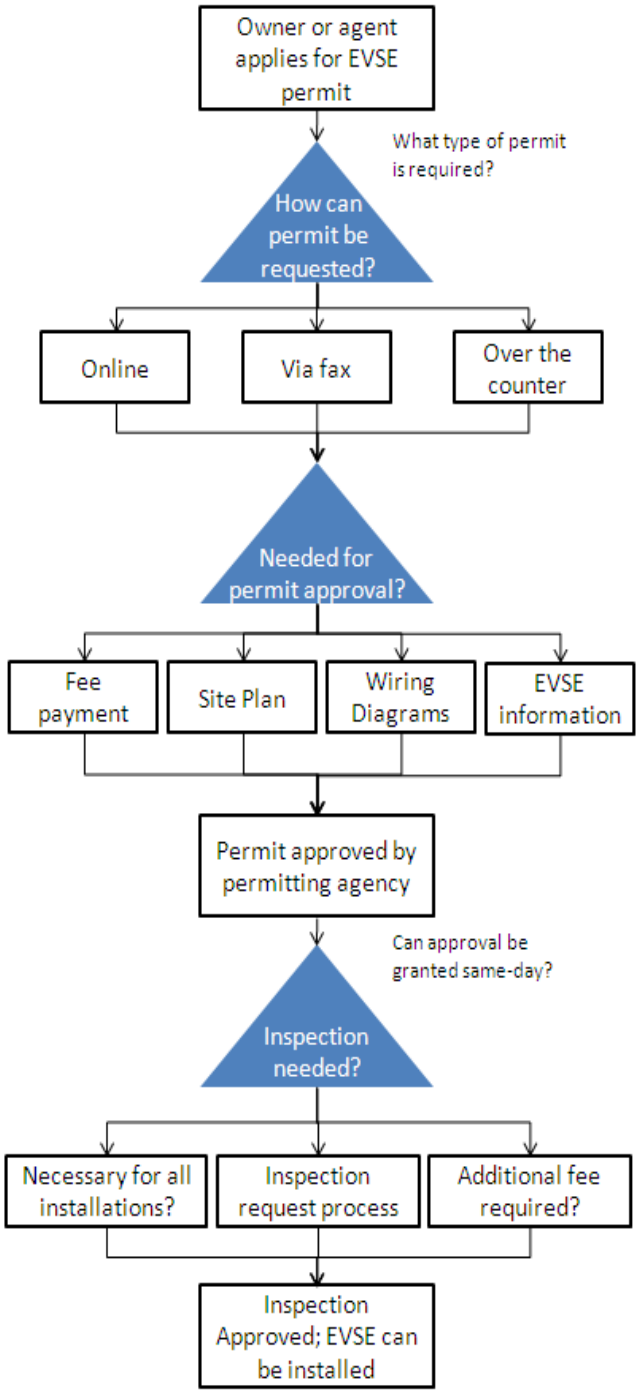
- Is an inspection required to approve the EVSE installation?
- What is the typical time required from inspection request to inspection approval?
- What is the cost of inspection? Is it included in the permit cost?
- How can an inspection be requested?

Future Process Questions

- How long can the installation process take without hindering the adoption of EVs in the area?
- What resources or funds are available to revise the process and put new systems in place?

Process Review and General Recommendations

Based on challenges identified using the above questions, localities can focus on one or two problematic steps in their own installation process. Information on how these bottlenecks could be expedited or streamlined has been collected from other Project Get Ready efforts across the country and illustrated in the graphical example. The Houston and Raleigh PGR efforts and information provided by the PGR website were referenced. Using the graphic and table on the next page, different strategies (shown in the table on the right) can be utilized based on the answers to the above questions (shown in the graphic on the left).



Allow EVSE owner's selected agent to apply for permit; in many cases, localities which could interact directly with the owner's electrical contractor had fewer challenges. Establish an online permit request *and approval* process. Allow agents to access, submit, and receive approval for EVSE permitting online. If these IT systems cannot be put in place, post permitting forms online and allow agents to email or fax in forms when submitting (can still require agents to come to office to receive permit approval).
Simplify and consolidate permitting fees. Limit the information required for approval. On residential installations, require only fee payment and permitting forms. On commercial installations, limit requirement of site plans or additional information (require only for complex installations). Streamline the number of agencies that touch the EVSE permitting process. If possible, allow one agency to handle the entire process from permit receipt through final inspection approval. Expedite the permit approval process to decrease wait time.
When possible, limit the inspections required. If required for all installations, work to streamline the inspection request process (online, phone, etc.). Expedite EVSE inspections with a goal of 48 hour turnaround times following installation. Simplify and consolidate inspection fee (loop into permit fee).

Overall Recommendations for Residential and Commercial Processes

- Work to increase interaction and education of all involved parties including agencies, agents, inspectors, and general public.
- Decrease time required for each process step

Virginia Localities Survey Results

This section describes the EVSE installation processes established within Virginia localities. This information was gathered through the basic locality survey process described in Appendix 1. Using the Appendix 1 information gathered from other PGR groups as a guide, Virginia localities can target a few areas of their EVSE processes for improvement. This information has been provided as an example and actual implementation of streamlining efforts will depend on available resources at each locality.

The localities listed below were targeted in parallel with the availability of the first EV models and based on Department of Energy programs to roll-out grant funded EVSE infrastructure. Northern Virginia is being targeted for the first Chevrolet Volt[1] models due out by the end of 2010 and also by the Charge Point America[2] infrastructure program. Densely populated urban centers outside of Northern Virginia were included based on accepted consumer attitudes for new technology adoption, and government and military density in those areas.

Five localities have been listed in the body of this document, but additional Virginia localities' processes can be found in Appendix 2, including Arlington, Henrico, and Charlottesville. Additional data from the four featured localities can also be found in Appendix 2 with points of contact points for each locality.

Northern Virginia: Fairfax County

Fairfax County is preparing for electric vehicles by putting in place a new online permit request and approval process for EVSE installation. Fairfax staff indicated that basic permits can be approved within 20 minutes if applied for at certain times in the day. Costs are streamlined, and electrical plans are required only for commercial installations.

Locality	Permit	Who can request?	Process	Process Costs	Inspection	Electrical Plans	Additional
Fairfax County	Electrical; Building permit if a concrete pad is needed	Homeowners, licensed contractor and authorized agent	Request permit from Dept. of Public Works and Environmental Services: Same-day over the counter permit. Installation Completed. Inspection process for approval.	Residential: $85 Commercial: $85	Required for all installations, included in permit price	Plan required for commercial installations.	Online permit request and approval process in place by the end of 2010.

Loudoun County

Loudoun County has a process very similar to Fairfax County's process, except that approved over-the-counter permits may not be available same day. Inspections are required for all installations and electrical plans are required for commercial installations. There is no current plan to move to an online permitting system.

[1] General Motors, www.Chevrolet.com/Volt
[2] Coulomb Technologies, ChargePoint America, www.coulombtech.com

Locality	Permit	Who can request?	Process	Process Costs	Inspection	Electrical Plans	Additional
Loudoun County	Electrical	Homeowners, licensed contractor and authorized agent	Request permit from Dept. of Building and Development: Over the counter permit. Installation Completed. Inspection process for approval.	Residential: $70 Commercial: $95	Required for all installations, included in permit price	Plan required for commercial installations.	

Richmond Metro Area: City of Richmond

The City of Richmond currently has a same-day permit process for over-the-counter requests and it is implementing a new IT process that will enable online permitting and approval. Richmond is developing its online presence to host information on EVs and EVSE installations for potential EV-owners in the community. The city also plans to meet with local electrical contractors and trade associations to understand the necessary processes and procedures to prepare for electric vehicles.

Locality	Permit	Who can request?	Process	Process Costs	Inspection	Electrical Plans	Additional
City of Richmond	Electrical	Property Owner, Licensed Contractor, or Authorized Agent of Owner	Request permit from Dept of Planning and Development Review: Same-day over the counter permits, additional fax or mail (no timing provided). Installation Completed. Inspection process for approval.	Residential: $0-$2000 = $63; $6.064 per additional $1000 cost* Commercial: $0-$2000 = $131; $8.489 per additional $1000 cost*	Required for all installations, included in permit price	Required for commercial projects that exceed $3000 and for public installation projects	City will have a new permit IT process implemented by Fall 2011 that will enable online permit application and approval

*does not include 2% state surcharge

Hampton Roads Area: City of Norfolk

The City of Norfolk states that it is "familiar with the technology and prepared to embrace the demand for installations." They have a same-day permit process for over-the-counter requests and also offer a fax option. Process costs vary and inspections are required for all installations (but are included in the permit price). Electrical plans are not required.

Locality	Permit	Who can request?	Process	Process Costs	Inspection	Electrical Plans	Additional
City of Norfolk	Electrical	Contractor or Electrician	Request permit from Bureau of Business Safety: Same-day over the counter permit, fax OK (no timing provided). Installation Completed. Inspection process for approval.	Residential: Varies Commercial: Varies	Required for all installations, included in permit price	No plan required	

Albemarle County

Albemarle County bases its permitting structure on the number of inspections required for an installation. Over-the-counter residential permits can be approved immediately, but commercial plans may be lengthy depending on the timeliness of the correct forms that are required. A variety of information is required before commercial permits can be approved.

Locality	Permit	Who can request?	Process	Process Costs	Inspection	Electrical Plans	Additional
Albemarle Country	Electrical	Property owner, property owner's agent (including contractor)	Request permit from correct office in Department of Community Development: Over the counter residential permit issued immediately. Commercial must bring proper plans and takes 3-4 days. Installation Completed. Inspection process for approval.	Residential: $30 per inspection* (average 1-2 inspections needed) Commercial: Same as residential (more inspections needed based on difficulty of installation)	Required for all installations. See "Process Costs."	Residential: No plan required for residential permits. Commercial: Two copies of each of the following: schematic wiring diagrams, manufacturer's literature on specific product, and site plan or equivalent	

*does not include 2% state surcharge

Next Steps and Additional Recommendations

Additional recommendations for streamlining the installation process and educating stakeholders are included below. These additional processes require extensive revision to existing systems that are not anticipated in the short-term. Localities may be interested in developing a long-term plan to adopt one or more of these strategies. These strategies will likely have a dramatic positive impact on reducing overall installation timelines.

E-permitting with random inspection process

One process adopted by a number of localities in the Portland, Oregon area was the introduction of an e-permitting and random inspection process for EVSE installation. The Oregon Building Code Department has expanded an existing "minor label program" that can currently be used by electrical contractors for the installation of branch circuits up to 30 amps at 240 volts. The division has expanded this program to cover the installation of a 40 amp, 240-volt branch circuit and the connection of EVSE in one and two family dwellings, where the EVSE is in an attached garage. From a Building Code Department document: "The installation labels are about a tenth the cost of a regular permit, and only a tenth of the installations get inspected. Nine out of ten installations done under the minor label program will not be inspected to be sure that the existing service equipment has adequate capacity for the additional load of the EVSE." The Department does note that it may be prudent to require 100% inspection of the first hundred installations. This process will dramatically reduce the amount of time and cost required for the permitting and inspection process, and is something Virginia localities may want to think about investigating as a long-term goal. See Appendix 3 for more information and an example of this e-permitting program.

Virginia building code requiring new construction to be pre-wired for EVs

A final strategy for dramatically reducing the process time for EVSE installation requires involving the Virginia Board of Housing and Community Development to mandate the pre-wiring of new homes with and/or the installation of inexpensive conduit for cables for future EVSE wiring. British Columbia has recently instituted a requirement similar to this. This requirement drastically decreases the potential installation cost for a Level 2 residential EVSE. The adoption of a new home building code would require homebuilders to install wiring for EVSE at the time of any new construction. Costs for this type of pre-installation are negligible, and pre-installation protects against the future substantial EVSE installation cost. In order to implement this type of requirement, the Virginia Board of Housing and Community Development would have to approve an amendment to the Virginia Uniform Statewide Building Code. Once this is accomplished, localities can begin implementing the requirements.

Additional Recommendations

Additional recommendations gathered from other PGR groups include the following:

1. EV buyer installation guides on-line and in EV purchase centers. As noted on the Rocky Mountain Institute PGR website, a number of localities across the nation are preparing for the wave of new EV owners by updating their websites to host a range of EV information. In particular, many localities are moving to supply installation guides for individual EV owners to tell them how the permitting and inspection process will work for their locality. These installation guides could also be available at local events and EV dealerships to distribute to potential EV buyers. A sample EVSE Installation Guide template is available in Appendix 4. This type of communication is recommended for all Virginia localities and covered in more detail in the Education Section of this report.
2. Online communication of EV information. As a supplement to installation guides, many localities are beginning to host general EV information including:
    a. Types of EVs available with timing assumptions
    b. Types of EVSE and how to decide which level is "best for you"
    c. Projected installation cost calculator based on a few key features of your home

Areas for future exploration

Due to the goals and constraints of this document, information regarding military and university installations and permitting has not been included. These locations are projected to be key EV adoption areas and information for these locations should be included in future drafts. Also, DC Fast Charging (sometimes incorrectly termed Level 2 charging) regulations have not been included in this document due to lack of current standardization.

Sites and Installation

This section outlines the components in charging infrastructure and charging equipment and documents the comprehensive requirements for installation of charging stations in public, private, and residential locations. This section includes cost estimates and refers to issues that extend from the installation of charging infrastructure, such as signage concerns, liability, reserved parking, accessibility for persons with disabilities, and management of spaces.

Brief Overview of Charging Infrastructure:

Photo: Virginia Clean Cities

Onboard Vehicle Charging Components:

- Battery
- Onboard Charger
- Power Inlet

} Located inside the vehicle.

Photo: Virginia Clean Cities

Level 1 and 2 Electric Vehicle Supply Equipment (EVSE) consists of the following:

- Charger control device (includes a Society of Automotive Engineers (SAE) J1772 compliant connector that plugs into the vehicle's inlet)
- Coupler (consists of the J1772 Connector and Inlet)
- Interface to utility or local renewable power (either 120 VAC or 240 VAC outlet)

The J1772 Connector

With the J1772 connector, the vehicle charger has the ability to communicate with the EVSE to determine the circuit rating and adjust the charge to the battery accordingly. For example, an EVSE that is capable of delivering 25 amps will deliver that current even though it may be connected to a 40 amp rated circuit.[3]

The J1772 Standard and National Electric Code requirements are as follows:

The EV coupler –

- Must be designed to prevent inadvertent disconnection
- Must have a grounded pole that is the first to make contact and the last to break contact.
- Must contain an interlock component that prevents the vehicle from being started while connected.
- Must be specifically designed for electric vehicle charging and unable to be used for other purposes.

The EV inlet-

- Must remain de-energized until it is attached the EVSE.
- Must de-energize prior to removal of the connector.

The EVSE –

- Must be tested and approved for use by Underwriters Laboratory.
- Must be able to initiate area ventilation for specific batteries that may emit potentially explosive gases.
- Must have charge current interrupting device (CCID) that will shut off the electricity supply if it senses a potential problem that could result in electrical shock to the user.[4]

J1772 Connector

J1772 Inlet (right side)[5]

[3] Electric Transportation Engineering Corporation, *Electric Vehicle Charging Infrastructure Deployment Guidelines British Columbia*, Version 1.0, July 2009.

[4] Electric Transportation Engineering Corporation, *Electric Vehicle Charging Infrastructure Deployment Guidelines for the Oregon I-5 Metro Areas of Portland, Salem, Corvallis and Eugene*, Final Version 3.1, April 2010.

Power Requirements and Charge Times of the Three Levels of Charging Infrastructure

Level 1

Level 1 charging utilizes a standard 120-volt AC (VAC) branch circuit. 120-VAC is the lowest level of common voltage found in residential and commercial buildings. Resulting typical voltage is usually 110-120-VAC. Typical amperage is 15 amp or 20 amp. Level 1 charging provides a maximum demand between 1.2 and 1.6 kW. This is a lower demand level than provided by Level 2 or 3 and, therefore, results in longer charge times. For example, to charge a PHEV 40 vehicle, such as the Chevrolet Volt, 5 to 13 hours would be required to reach full charge. For an EV100, such as the Nissan Leaf, 8 to 15 would be required for full charge. [6]

For Level 1 charging, a user can plug in to a typical existing 120-VAC outlet found in a residential or commercial structure. However, when using Level 1 charging, a dedicated branch circuit is recommended because existing 120-VAC branch circuits usually include multiple outlets served by a single circuit breaker that provides overload protection. Other devices or multiple electric vehicles using the same branch circuit could result in tripping a breaker due to an overload condition.[7]

Level 2

Level 1 charging specifies a 240-VAC, single phase branch circuit. A current rating of 40 amp is typical; however, the J1772 connector allows for current as high as 80 amps AC. Instantaneous demand levels for Level 2 charging can vary but will generally fall between 3.3 kW and 7.7 kW with 40 amp current. Charging time is quicker with Level 2 EVSE since it allows for higher current flows. With Level 2 capability, 2.5 to 5 hours of charge time would generally be required to achieve a full charge in a PHEV 40 vehicle. For an EV100 vehicle, 3 to 5 hours would generally be required to reach a full charge utilizing Level 2 capability.[8] (Note: The amount of time to reach a full charge will vary widely based on battery size, amperage, voltage, demand capability, and amount of charge currently remaining on the vehicle's battery).

Due to the higher voltage of Level 2, there are also stricter safety requirements under the National Electric Code (NEC), including the requirement that the connector and cord be hard-wired to the control device and premises wiring.[9]

---

[5] Source for images of both the J1772 Connector and the J1772 Inlet: Electric Transportation Engineering Corporation, *Electric Vehicle Charging Infrastructure Deployment Guidelines for the Oregon I-5 Metro Areas of Portland, Salem, Corvallis and Eugene*, Final Version 3.1, April 2010.

[6] *U.S. DOE Vehicle Technologies Program – Advanced Vehicle Testing Activity: Plug-in Hybrid Electric Vehicle Charging Infrastructure Review*, Final Report Battelle Energy Alliance, Contract No. 58517, Idaho National Laboratory, November 2008.

[7] Ibid.

[8] Electric Transportation Engineering Corporation, *Electric Vehicle Charging Infrastructure Deployment Guidelines for the Oregon I-5 Metro Areas of Portland, Salem, Corvallis and Eugene*, Final Version 3.1, April 2010.

[9] Ibid.

Level 3(DC Fast Charging)

Level 3 or "Fast Charging" is intended for commercial and/or public applications. Level 3 typically utilizes an off-board charge system serviced by a 480-VAC, three-phase utility service. The off-board charger provides the AC to DC conversion. The vehicle's on-board battery management system controls the off-board charger to deliver DC directly to the battery.[10]

Level 3infrastructure provides for the fastest charging possible. A PHEV 40 vehicle like the Chevrolet Volt is not compatible with Level 3 charging. However, an EV100, such as the Nissan Leaf, can achieve full charge with Level 3 EVSE in 15 to 30 minutes. Big box retailers, grocery stores, and shopping centers are examples of where 480-VAC, three-phase utility service would be pre-existing in order to allow for installation of Level 3 DC Fast Chargers.

SAE has not yet settled upon a standard for Level 3 charging; however, Nissan has indicated that the Leaf will come equipped with the Japanese standard CHAdeMO (Charge then Move) Level 3 receptacle in addition to the standard Level 2 receptacle. Yet, the level of functionality of the receptacle without the need for additional hardware is unclear at this point.[11]

Level of Charging	Level 1	Level 2	DC Fast Charge (Level 3)
Voltage	120 VAC	240 VAC	480 VAC (off board charger provides AC to DC conversion)
Amperage	15 - 20 Amp	40 - 80 Amp	85 Amp
Instantaneous Demand	1.2 - 1.6 kW	3.3 - 7.7 kW	60 kW
Charge Time			
PHEV 40 Vehicle	5 - 13 hours	2.5 - 5 hours	N/A
EV100 Vehicle	8 - 15 hours	3 - 5 hours	15 to 30 minutes

[10] Ibid.

[11] Planet Better Place, Report: Nissan Discusses Leaf Charging Options, June 2, 2010 http://planet.betterplace.com/forum/topics/report-nissan-discusses-leaf.

Charging Scenarios

Single Attached/Detached Garages

Power Requirements[12]:
Recommended for Level 1: Dedicated Branch Circuit with NEMA 5-15R or 5-20R receptacle.

Recommended for Level 2: Dedicated Branch Circuit hardwired to a permanently-mounted EVSE with the following specifications: 240-VAC/Single Phase, 40 Amp breaker.

General Cost Estimates:
Cost estimate scenarios will be provided in detail later in the document.

Level I: A general estimate for installation of a 20 Amp branch circuit, 120-VAC/1-Phase, including labor, materials and permits has been estimated at $878[13].

Level II: A general estimate for installation of a 40 Amp, Level 2 EVSE including labor, materials, and permitting has been estimated at $2,272[14].

However, costs will vary based on numerous factors such as:

- Length of circuit run;
- Potentially needed electrical panel upgrades;
- Labor costs for any necessary electrical upgrades;
- Utility service requirements; and
- Permitting costs.

Siting Requirements:
For an enclosed garage, the EV owner will want an indoor rated EVSE. The EVSE should be positioned to take into consideration where and how the owner will park the car and, of course, where the charging inlet is located on the vehicle. Many times the EVSE will be positioned on an exterior wall to decrease the distance from an electrical panel box and also to position the EVSE out of the way. It is important to keep the EVSE as close as possible to the charging inlet on the vehicle in order to minimize the length of cord on the floor, which could lead to a tripping hazard.[15]

---

[12] Electric Transportation Engineering Corporation, *Electric Vehicle Charging Infrastructure Deployment Guidelines for the Oregon I-5 Metro Areas of Portland, Salem, Corvallis and Eugene*, Final Version 3.1, April 2010.

[13] *U.S. DOE Vehicle Technologies Program – Advanced Vehicle Testing Activity: Plug-in Hybrid Electric Vehicle Charging Infrastructure Review*, Final Report Battelle Energy Alliance, Contract No. 58517, Idaho National Laboratory, November 2008.

[14] Electric Transportation Engineering Corporation, *Electric Vehicle Charging Infrastructure Deployment Guidelines for Greater San Diego Area*, Version 3.1, May 2010.

[15] Ibid.

Installation:

Generally, EVSE in a residential garage will consist of installing a dedicated branch circuit from an existing premise distribution panel to an EV outlet receptacle (120-VAC) in the case of Level 1 charging or an EVSE (240-VAC) for Level 2 charging.

Level 2 Considerations:[16]

- For new construction, bring the circuit to a dual gang box (contains one service lateral to accommodate dual metering) with a cover plate for future installation of EVSE. Having the dual gang box will allow for dual metering so the EV owner could take advantage of off-peak EV charging rates that may be offered by the utility.
- For new construction that is incorporating an advanced internet network within the premise, an Internet connection at the EVSE is recommended.
- For an existing garage, in addition to siting the EVSE, the EV owner may want to have the utility install a second meter or set up a sub-metering scenario in order to take advantage of off-peak EV charging rates that may be offered by the utility.
- If the Level 2 EVSE supplied does not provide controls to allow for charging at programmable times to enable off-peak charging, a homeowner may wish to install a timer device in this circuit to control charging times.

Steps that the EV purchaser will need to take to ensure that he/she arranges for the correct charging infrastructure include:

- Interface with EV dealer to determine whether Level 1 or Level 2 will be the preferred EVSE and whether ventilation is required. Ventilation will generally not be required unless the EV contains a lead acid battery or a zinc air battery that can allow off-gassing. Most EVs coming to market in 2010 and beyond will have lithium-ion batteries that will not require ventilation.
- Contact utility to obtain information on any necessary utility service requirements on rate options. If the utility offers a special EV rate, the EV owner may need a second meter installed or may need to arrange for sub-metering.
- Consult with a licensed electrician to plan the installation
    - Submit required permitting documents and plans
    - Coordinate completion of the EVSE installation and final inspection, as required.

[16] Electric Transportation Engineering Corporation, *Electric Vehicle Charging Infrastructure Deployment Guidelines for the Oregon I-5 Metro Areas of Portland, Salem, Corvallis and Eugene*, Final Version 3.1, April 2010.

Example of a Level 2 Residential Garage Charger Installation

Photo: Coulomb Technologies.

Carports

Power Requirements and Cost Estimates:

Same as for above referenced garage scenarios.

Siting and Installation Requirements:

Since a carport is considered an outdoor area, the EVSE should be designed for exterior use. Factors unique to outdoor conditions such as weather, temperatures, and lighting need to be considered. Freezing temperatures can cause cords to freeze to parking surfaces, so cord support should be considered. Sufficient lighting will need to be installed for practical and safety reasons. The installation process is similar to that outlined for the attached/detached garage scenario except that exterior-rated EVSE will be needed.

Multi-Family Dwellings

Power Requirements:

Same as for above-referenced garage scenarios.

Cost Estimates:

Estimates range between $833 per charger for Level 1 and $1,520 per charger for Level 2 (these estimates assume five EVSE installed at one time).[17] Costs will vary based on factors such as those listed below:

- length of circuit run;
- potential utility service requirements;
- potentially needed electrical panel upgrades;
- labor costs for any necessary electrical upgrades;
- number of wall boxes and charge cords installed at one time (assume economies of scale will reduce per unit costs); and
- permitting and administrative costs.

Siting Requirements:

In the case of multi-family dwellings, the apartment or condominium complex owner or home owners' association will need to be involved in siting decisions. The EV purchaser should consult the appropriate individuals well in advance to ensure all necessary details are agreed upon, such as location of the EVSE and ownership of the EVSE. If the EV owner ever relocates, electrical upgrades including raceway and panel upgrades will be retained by the owner of the complex, therefore ownership of the EVSE needs to be clarified from the beginning. If the EV owner plans to own the EVSE, he may be responsible for circuit removal and site restoration. Metering issues will also be involved so the EV owner should consult the utility regarding how these issues will be resolved if the EV owner moves.

In a multi-family dwelling situation, the EVSE will likely not be protected from the environment so outdoor-rated EVSE will be needed. Location of the EVSE may be limited to the front of a parking space unless an adjacent wall is available. The EVSE should be positioned at the vehicle side of any walkway to minimize the tripping hazard from the cord. The walkway for pedestrians should be on the back side of the EVSE. A wheel stop will be required, so care should be taken to ensure that EV parking is not in an area of regular pedestrian traffic in order to prevent tripping over the wheel stop.

Overall consideration should be given to maintaining a safe and secure area around the parking spaces containing the EVSE to avoid tripping hazards or impediments with other activities in the area.[18]

[17] Ibid

[18] Electric Transportation Engineering Corporation, *Electric Vehicle Charging Infrastructure Deployment Guidelines for the Oregon I-5 Metro Areas of Portland, Salem, Corvallis and Eugene*, Final Version 3.1, April 2010.

Installation

Trenching and concrete repairs may be necessary, as well as a review by an electrical contractor, to determine whether the existing service panel is sufficient to support the circuit. Even if a raceway-containing conduit has been previously installed, a permit will still be required for installation of the EVSE.

In a situation in which installation of multiple parking spaces with EVSE will be necessary, the services of an electrical consultant may be prudent to determine how best to structure the siting and installation. The electrical consultant can help with issues such as a load control plan to manage the EV charging load within the capacity of the existing electrical service to the building, in order to avoid an electrical service upgrade unless one is absolutely necessary to accommodate EV charging.[19]

Commercial Fleets

Power Requirements:

Commercial Fleets will likely utilize Level 1 Charging. Therefore, the power requirements include a Dedicated Branch Circuit hardwired to a permanently-mounted EVSE with 240-VAC/Single Phase, 40 Amp breaker.

Commercial Fleet installation will likely include multiple charge points and resulting additional electrical load and new construction. The sizing of the main service entrance section (SES) will need to be considered. Upgrades to SES and/or utility supply may be required.

Due to the potentially significant electrical load, it is recommended that a network connection is provided in close proximity to the charge stations, to interface with building energy management system or to enable local utility control strategies.[20]

Cost Estimates:

Costs are estimated between $18,519[21] and $50,000[22] for a generic installation of **ten** EVSE. As with other scenarios, costs will vary based on the length of circuit run, any necessary trenching or other construction, electrical panel upgrades, etc.

Siting and Installation Requirements:

Significant attention should be given to planning for EV parking in fleet situations. Correctly sizing the EV parking and charging area will be critical. In addition to present requirements, fleet owners will also need to anticipate future requirements such as growth

[19] Ibid

[20] Ibid

[21] *U.S. DOE Vehicle Technologies Program – Advanced Vehicle Testing Activity: Plug-in Hybrid Electric Vehicle Charging Infrastructure Review*, Final Report Battelle Energy Alliance, Contract No. 58517, Idaho National Laboratory, November 2008.

[22] Electric Transportation Engineering Corporation, *Electric Vehicle Charging Infrastructure Deployment Guidelines for the Oregon I-5 Metro Areas of Portland, Salem, Corvallis and Eugene*, Final Version 3.1, April 2010.

of the fleet. Electrical service requirements will be much greater than in residential or multi-family installations and can have a large impact on electrical usage and on the utility. Therefore, fleet owners will need to work with electric utility personnel in planning the siting and installation of its EVSE.

Fleet owners will likely be interested in off-peak charging services and will need to consult the utility to determine what rate options are available and whether metering changes will need to be made.

Fleet owners will also need to think about dealing with flooding issues and avoiding flood prone areas. While the Level 2 EVSE will contain the proper protection device for use in flood prone areas, employees may not be comfortable operating the EVSE in standing water.

Proximity to the electrical service will be an important factor in locating the EV fleet parking area since installation of the EVSE in a commercial facility generally requires installation of new, dedicated branch circuits from the central meter.

Fleet managers will want to ensure safety in the EV parking area. This will include awareness of other equipment to be stored near the EV parking area and the need to ensure a hazardous environment does not exist for the planned area.

Depending on the needs of the business, fleet owners may want to consider installation of DC fast-charging equipment, which will enable a much faster charge and decreased cycle time for charging vehicles. The 480-VAC, three-phase service required for DC fast-charging is usually available in large commercial facilities. The installation process will involve permitting issues similar to those required for other scenarios; however, more detailed planning will likely be involved in siting and installing fleet EVSE.[23]

Example of a Level 2 commercial electric vehicle charger installation[24]

[23] Ibid

[24] *U.S. DOE Vehicle Technologies Program – Advanced Vehicle Testing Activity: Plug-in Hybrid Electric Vehicle Charging Infrastructure Review*, Final Report Battelle Energy Alliance, Contract No. 58517, Idaho National Laboratory, November 2008.

Public Charging

It is projected that 80% of vehicle charging will be done at home. This prediction is confirmed through comments from vehicle manufacturers throughout Virginia's readiness efforts. Secondary to home charging, electric vehicle owners will also need to charge at the workplace and other commercial establishments. However, appropriately placed public charging capability will be necessary, to enhance consumer adoption of electric vehicles and to respond to the issues of range anxiety that EV owners will experience.

Publicly available charging infrastructure may be installed on public property owned by public entities such as municipalities or utilities; however, publicly available infrastructure also may be owned by commercial establishments, such as retail outlets. Public charging may consist of a mix of Level 1, 2, and Level 3 DC Fast-Charging stations. However, due to the long charge times necessary for Level I charging, the installations of Level 1 chargers would be impractical for most EV owners' needs in the public domain. It is more likely that public charging infrastructure will consist of Level 2 and Level 3 DC Fast Charging Stations.

Selection of Level 2 EVSE sites should include consideration of locations where it is anticipated that the EV owner will be parked for a significant period of time (1 to 4 hours).

Selection of Level 3 DC Fast-Charging Stations should include consideration of locations where it is expected that the EV owner will be parked only for a short period of time (15 to 30 minutes). For DC Fast-Charging, 480-VAC/3-phase electrical service will be necessary.

Design and requirements of publicly available charging stations will vary significantly and they include a number of requirements unique to the public domain such as signage and payment mechanisms.[25]

Example of Public Charging Stations from Coulomb Technologies

[25] Electric Transportation Engineering Corporation, *Electric Vehicle Charging Infrastructure Deployment Guidelines for the Oregon I-5 Metro Areas of Portland, Salem, Corvallis and Eugene*, Final Version 3.1, April 2010.

Power Requirements

Level 2:

Dedicated branch circuits hardwired to permanently mounted EVSE with 240-VAC/single phase service with a 40 amp current rating.

DC Fast Charging:

Dedicated branch circuit hardwired to DC Fast-Charge station. DC Fast-Chargers will generally require 480-VAC/3-phase service with a 60 Amp breaker for 30 kW output or a 125 Amp breaker for 60kW output.[26]

Communication methods will probably be desired for publicly available charging stations, but they are not absolutely necessary. Communications systems may include those utilizing power lines, wired Internet or wireless Internet.

Cost Estimates

Because design and requirements of publicly available charging stations will vary significantly, costs can also vary within a wide range, depending on how much infrastructure work needs to be done to support the chargers (trenching, construction, concrete work, electric upgrades, etc.).

Costs for EVSE installation can be reduced with strategic locating near electric service infrastructure, as well as planning for limited trenching in outdoor installations. Advanced planning, such as pre-installing conduit during parking lot refurbishment, can avoid costs of installing the conduit later.

Level 2:

For a generic installation of **two publicly available Level 2 charging stations** when the two charging stations are located side-by-side where cars are facing each other, as in a parking lot scenario, costs are estimated to fall between $15,000 to $18,000.

DC Fast Charging:

For a generic installation of two publicly available DC Fast-Charging stations at one location, costs are estimated to fall between $65,000 and $70,000.

As in all EVSE installation scenarios, costs will vary depending on length of circuit run, trenching, electrical panel upgrades, and many other factors.[27]

[26] Ibid

Siting and Installation:

Issues such as ownership, vandalism, payment, maintenance, and data collection, along with many other considerations, arise in public charging situations. Weather, flood-prone restrictions, pedestrian traffic, safety, signage, lighting, and shelter also will be significant issues with regard to publicly available charging infrastructure.

For publicly available sites, it will also be necessary to consider accessibility of EVSE for persons with disabilities.

Lighting and shelter will be of utmost importance in public parking locations. The EV owner will need to be able to read instructions and have sufficient lighting to operate the EVSE. Lighting will also enhance safety.

Installation of EVSE in public areas generally involves installing new, dedicated branch circuits from the central meter distribution panel to a Level 2 EVSE, of which there will likely be many installations grouped to serve adjacent parking spaces. Proximity to the electrical service will be an important factor. The length of the circuit run and number of EVSE spaces will have an impact on cost. Cost issues will need to be balanced with consideration for convenience and local area aesthetics. Trouble reporting is also an important factor in public charging situations. Each publicly available charging area should contain a mechanism for the EVSE user to contact the equipment owner regarding any trouble with the equipment.

Planning for public charging infrastructure and service will require more detailed planning than any other charging scenario yet discussed. Superior advanced planning will ensure optimal placement of public charging infrastructure and enhance adoption and user acceptance.[28]

Signage

EV signage will have two purposes: helping EV owners locate charging stations and keeping non-electric vehicles from parking in charging station spaces. Red on white standards for no parking as detailed in the Manual on Uniform Traffic Control Devices (MUTCD) will work best to keep non-EV owners from parking in EV charging spaces. Blue signs can be mistaken for accessible locations. Green signs can be mistaken for short-term parking spots. White on blue configuration is one option for EV charging station way-finding. A number of designs of EV parking signs were developed in the 1990's and national leaders are considering standard designs for signage most appropriate for the current generation of electric vehicles.[29] Signage is also discussed in the incentives section of this document.

---

[27] Electric Transportation Engineering Corporation, *Electric Vehicle Charging Infrastructure Deployment Guidelines for the Oregon I-5 Metro Areas of Portland, Salem, Corvallis and Eugene*, Final Version 3.1, April 2010.

[28] Ibid

[29] Ibid

Examples of No Parking and EV Way-finding Signs[30]

Indoor Charging Safety Issues

As noted earlier, ventilation will generally not be required unless the EV contains a lead acid battery or a zinc air battery that can allow off-gassing. Most EVs coming to market in 2010 and beyond will have lithium ion batteries that will not require ventilation. Vehicle manufacturers will identify whether their batteries require ventilation. Lighting, tight access around the vehicle and storage of other materials also need to be considered in indoor charging scenarios.[31]

Paying to Publicly Charge an EV

Charging station providers have developed numerous methods for receiving payment from EV owners who use their public charging stations. Some providers offer a subscription service which EV owners can join that allows payment for a set number of uses or unlimited charging under a monthly fee scenario. These subscription services can involve the use of smartcards or Radio-Frequency Identification (RFID) fobs. Other providers allow for credit card swipes. Another option is a coin-operated meter that could be installed at the head of each EVSE parking space. Technology also exists for utilities to allow customers to charge an EV and have data feed back to their utility account so they can receive charges on their utility bill.

[30] Ibid
[31] Ibid

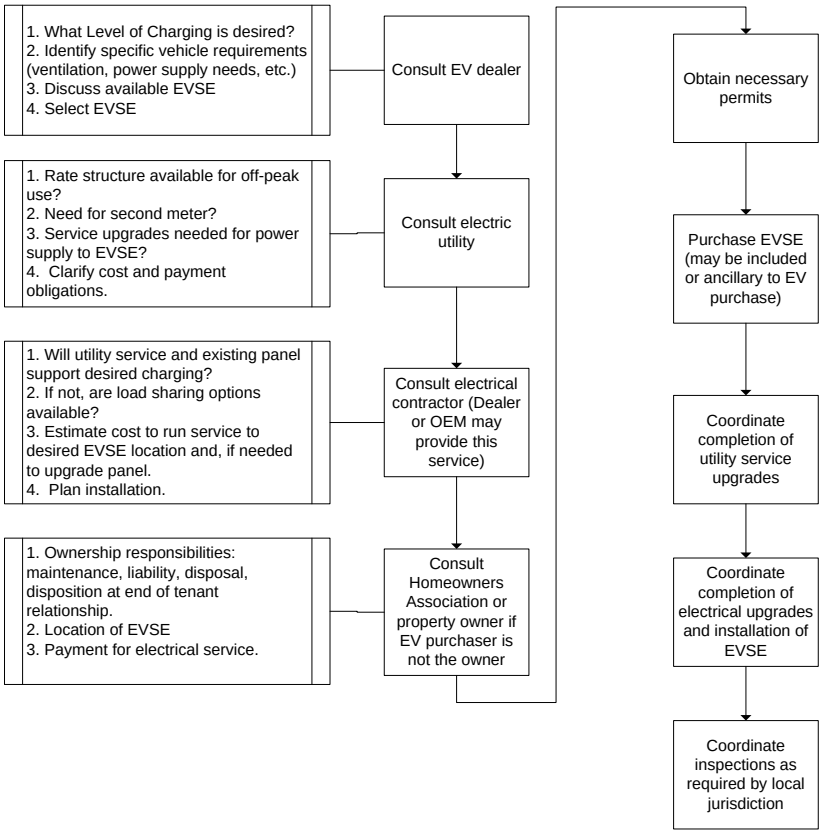
Data Collection

Scenarios such as subscription services using smartcards, RFIDs or utility technology that allows customers to pay for public charging via their utility bill translates to the ability to collect a substantial amount of data about where and when people are charging. This information can be valuable, not only in helping to plan future deployments of charging infrastructure, but also to help utilities track power usage resulting from EV charging.

Station Ownership

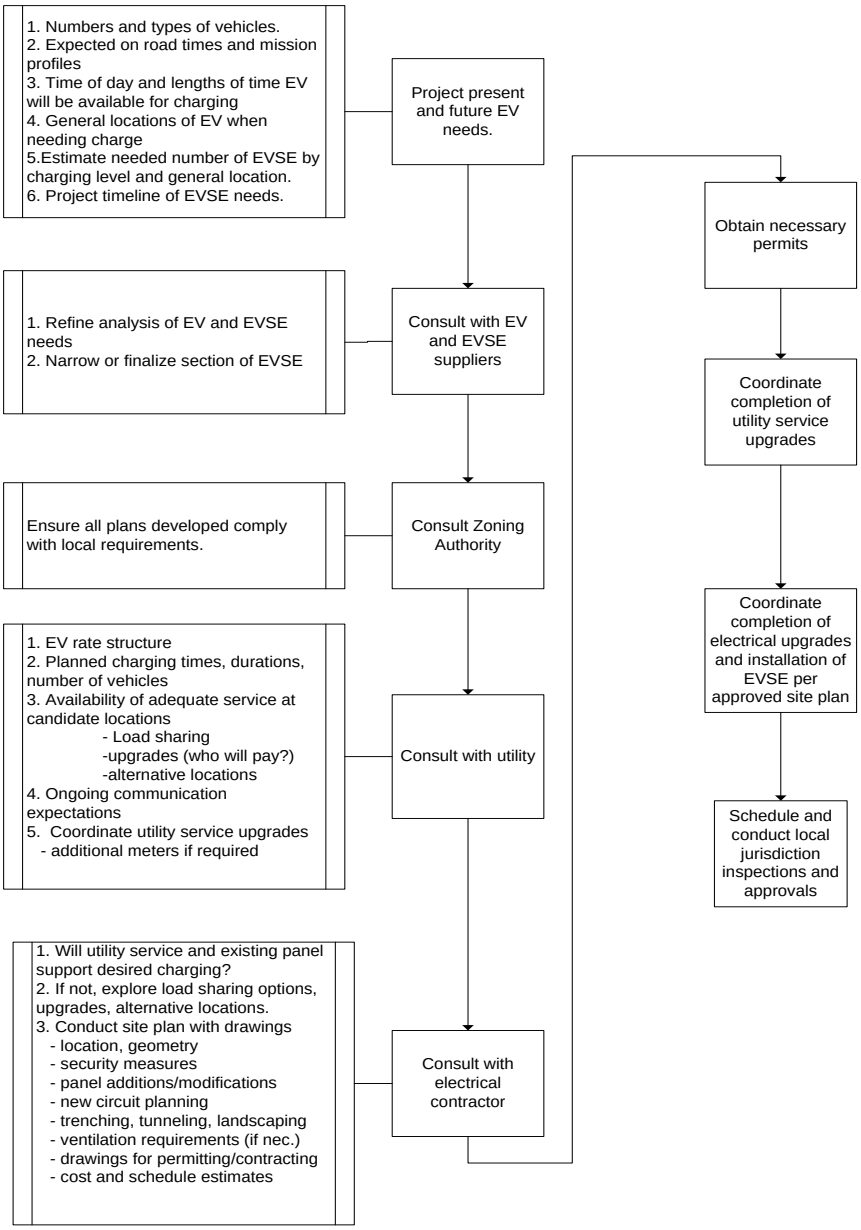
As with payment mechanisms, there are numerous structures for ownership of public charging stations. Business owners may wish to host public charging stations, but they may not have the legal authority to make changes to the parking lot. In cases like this, the business owner may own the EVSE, but another entity may be responsible for the work to connect to the electric infrastructure. The electric infrastructure may or may not be owned by the utility, depending on the regulatory rules that apply. Utilities may also wish to own and manage both the EVSE and the supporting electric infrastructure.

EVSE Installation – Residential



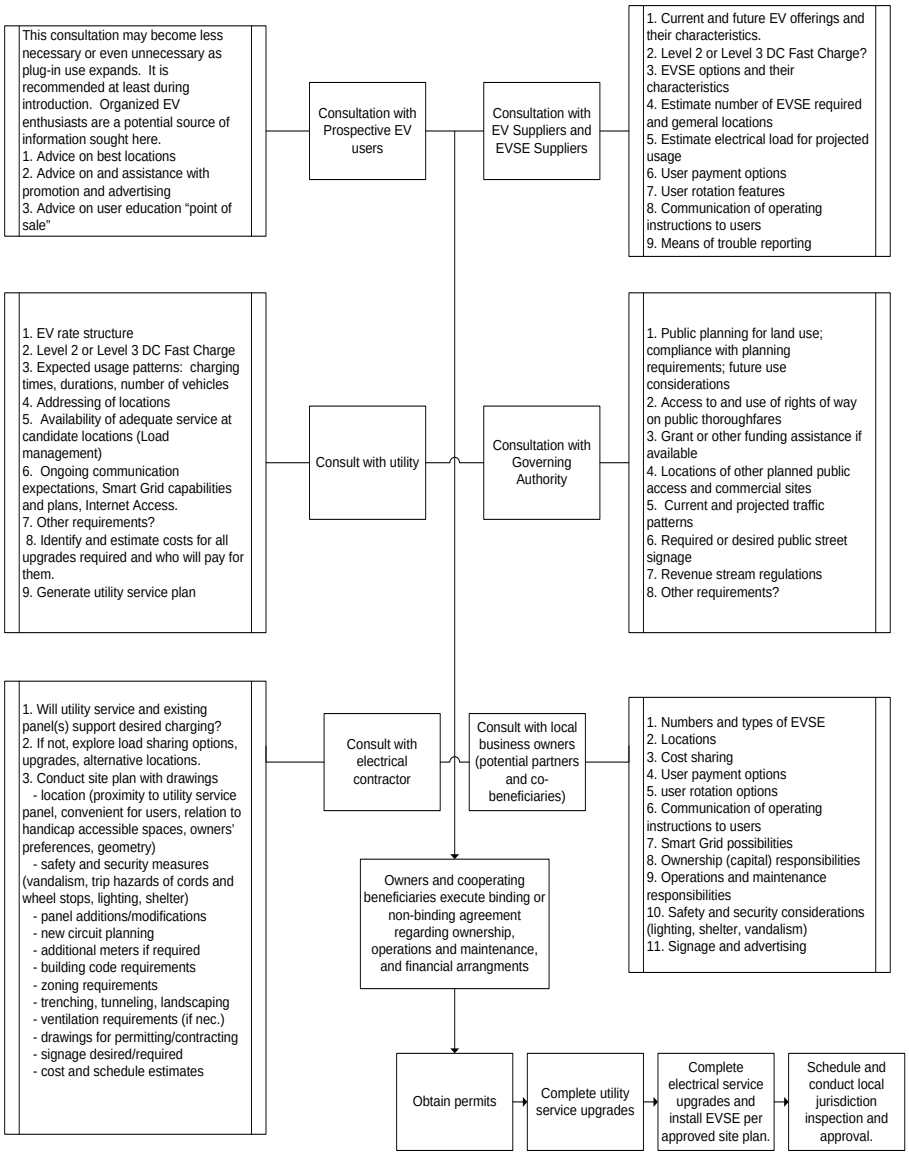
Note: Process may be slightly different for "on street" installation.
Consideration will need to be given to zoning, rights of way, security, and vandalism.

EVSE Installation - Fleet



Note: If EVSE must be located on public thoroughfare, consult with local jurisdiction regarding access and use of public property. Additional security, safety, and liability issues will need to be resolved.

EVSE Installation – Public (non-utility owned)



Estimating Cost

The following table[32] provides a cost estimate for a residential installation. This particular example does not assume the need for a service panel upgrade, although some homes will require one.

Residential Level 2			
Description	**Quantity**	**Cost Each**	**Total**
Labor (hrs)			
Initial Site Visit	2	$ 75.00	$ 150.00
Permit Application / Acquisition	2	$ 75.00	$ 150.00
Installation	8	$ 75.00	$ 600.00
Approval	2	$ 75.00	$ 150.00
Labor Sub-Total			$ 1,050.00
Materials			
EVSE - 40Amp	1	$ 780.00	$ 780.00
40amp Breaker	1	$ 35.00	$ 35.00
#12 THHN Wire	140	$ 0.30	$ 42.00
Conduit - 3/4 EMT	35	$ 3.00	$ 105.00
40Amp Fused Disconnect	1	$ 115.00	$ 115.00
Miscellaneous	1	$ 60.00	$ 60.00
Material Sub-Total			$ 1,137.00
Permit	1	$ 85.00	$ 85.00
		Total	**$ 2,272.00**

Note: The cost for EVSE installation may vary widely depending on EVSE provider, level of functionality, and any necessary associated electrical or construction work.

[32] Electric Transportation Engineering Corporation, *Electric Vehicle Charging Deployment Guidelines for Greater San Diego Area*, Version 3.1, May 2010.

The following table[33] provides a generic cost estimate worksheet for a commercial fleet charging installation with 10 Level 2 charging stations.

Commercial Fleet - 10 Stations			
Description	**Quantity**	**Cost Each**	**Total**
Labor (hrs)			
Initial Site Visit	2	$ 95.00	$ 190.00
Engineering	16	$ 90.00	$ 1,440.00
Permit Application / Acquisition	2	$ 95.00	$ 190.00
Installation	24	$ 95.00	$ 2,280.00
Approval	2	$ 95.00	$ 190.00
Labor Sub-Total			$ 4,290.00
Materials			
Distribution Panel (400amp)	1	$ 650.00	$ 650.00
EVSE - 40Amp	10	$ 2,500.00	$ 25,000.00
40amp Breaker	10	$ 35.00	$ 350.00
#12 THHN Wire	1000	$ 0.30	$ 300.00
Conduit - 3/4 EMT	250	$ 3.00	$ 750.00
40Amp Fused Disconnect	10	$ 115.00	$ 1,150.00
Signage	10	$ 250.00	$ 2,500.00
Miscellaneous	10	$ 60.00	$ 600.00
Material Sub-Total			$ 31,300.00
Trenching & Repair	200	$ 45.00	$ 9,000.00
Permit	1	$ 85.00	$ 85.00
		Total	**$ 44,675.00**

Note: The cost for EVSE installation may vary widely depending on EVSE provider, level of functionality, and any necessary associated electrical or construction work.

[33] Ibid

The following table[34] provides a generic cost estimate worksheet for a publicly available Level 2 Charging Station for two charging stations that are located side by side.

Publicly Available Charge Station - Level 2 (Qty 2)			
Description	**Quantity**	**Cost Each**	**Total**
Labor (hrs)			
Consultation with Property Owner/Tenant	4	$ 95.00	$ 380.00
Initial Site Visit	2	$ 95.00	$ 190.00
Engineering Drawings	16	$ 90.00	$ 1,440.00
Permit Application / Acquisition	2	$ 95.00	$ 190.00
Installation	24	$ 95.00	$ 2,280.00
Approval	2	$ 95.00	$ 190.00
Labor Sub-Total			$ 4,670.00
Materials			
Distribution Sub-Panel (100Amp)	1	$ 250.00	$ 250.00
EVSE - 40Amp	2	$ 2,500.00	$ 5,000.00
40amp Breaker	2	$ 35.00	$ 70.00
#12 THHN Wire	400	$ 0.30	$ 120.00
Conduit - 3/4 EMT	100	$ 3.00	$ 300.00
40Amp Fused Disconnect	2	$ 115.00	$ 230.00
Ground Signage & Striping (painted)	2	$ 125.00	$ 250.00
Signage (Post Mount)	2	$ 250.00	$ 500.00
Miscellaneous	2	$ 60.00	$ 120.00
Material Sub-Total			$ 6,840.00
Trenching & Repair	100	$ 45.00	$ 4,500.00
Permit	1	$ 85.00	$ 85.00
		Total	**$ 16,095.00**

Note: The cost for EVSE installation may vary widely depending on EVSE provider, level of functionality, and any necessary associated electrical or construction work.

Charger Location and Availability References

Range anxiety is seen as one of the major barriers to the large-scale adoption of electric cars. Range anxiety is the worry that the vehicle will not have a sufficient charge to make it to a distant final destination, thus stranding the occupants. This concern has led to calls for extensive public car charging networks. These fleets of commercial vehicles and individuals need to be able to locate and access a charge for their vehicles at a competitive price and within a reasonable distance. The sources below can assist in locating and promoting the infrastructure for alternative fuels.

[34] Ibid

The U.S. Department of Energy's Advanced Fuels and Data Center

Here you can choose by fuel type and state. Virginia currently has four electric car-charging stations publicly available and listed here. This station locator is also available as a mobile tool: http://www.afdc.energy.gov/afdc/locator/stations/state.

The National Renewable Energy Laboratory

Here you can choose by fuel type and state. The site also displays larger , interactive maps of alternative fueling infrastructure: http://rpm.nrel.gov/transatlas/launch.

The ChargePoint Network

You can search for electric car charging stations (Columb) within a selected radius. The locator is also available as a mobile tool: http://www.mychargepoint.net/find-stations.php.

Google Maps

Google Maps has an easy to use electric car charging station map. It also displays future sites that are not online yet:

http://maps.google.com/maps/ms?ie=UTF8&hl=en&msa=0&msid=116131265598797507695.0004514d08bc071d182cf&ll=37.09024,-103.974609&spn=43.528905,67.587891&z=4

Alternative and/or Innovative Domestic EV Charging Sources

Electric utilities already view the obligation to provide reliable electric power to their customers at reasonable and prudent costs as their number one priority. As energy demands continue to rise, smart grid technology offers an approach to more effectively accomplish this task. Smart meter devices allow two-way communication between customers' meters and the electric utility, using a secure wireless network technology. Full integration of smart grid technology will lead to more efficient use of the power grid, which will help reduce the amount of energy customers need as well as lower environmental emissions.

Electric vehicles are an example of a type of electric load that can be controlled through the use of smart grid technology. The EV's energy storage system is its battery. Delaying the charge of the battery usually has no impact on the customer, whereas turning off a customer's air conditioning in the middle of July in Virginia does. The smart grid will enable load controlling strategies – particularly the strategies used in multi-family residences – to maximize the utilization and effectiveness of existing transformers. Smart meters will enable the integration of numerous functionalities, such as direct load control, special pricing, and distributed generation and energy storage that will enhance the efficiency of the grid and decrease power consumption, especially at peak times. A long-term future possibility will be for EV owners to use the energy stored in the vehicle's battery to supplement the home's electrical requirements in times of peak demand.

Another alternative approach suggested by a Virginia solar company is fueling the energy used in the electric vehicle charging stations with renewable energy. The EV cars coming online now are designed to use a minimal amount of electricity. On Nissan's website, the Leaf is estimated to cost $2.64 in electricity for a full charge. At $.11/kWh, this is 24 kilowatt hours of electricity. In Virginia, a structure that could support 15 solar panels (about the size of a typical carport) could provide approximately 192 full charges annually. Of course, there is a higher initial cost to install this system, but there are also many federal incentives to offset the initial cost. There is a 30% federal tax credit available through 2016 for installing solar generation. This would lower the cost for those 15 panels to approximately $20,000. Renewable Energy Credits generated by the solar array would further offset the cost to install by another $6,000 over 5 years, assuming a $250 value each with no escalation. This brings the net cost down to $14,000. This is an 11 year payback, if there is an average 10% escalation in utility rates and the panels are warranted for 25 years.[35] It is not the only approach, but it is certainly a great approach to make the electric vehicle carbon neutral.

Charger Needs Analysis

Charger needs can vary widely between vehicle, fleet, and facility needs. A Needs Analysis was developed by the workgroup team, through Virginia's Advanced Vehicle Research Center in Danville, and is included in this program as Appendix 5.

Education and Outreach

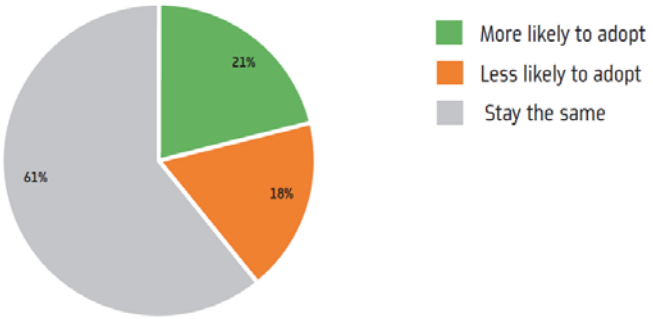
For successful deployment of electric vehicles throughout the Commonwealth, the knowledge gained through this project needs to be disseminated to appropriate partners, stakeholders and the general public. A strong, accurate, and consistent message will improve Virginians' collective understanding of these vehicles. The Education and Outreach group developed contacts for input among users, enthusiasts, providers of charge equipment, car manufacturers, car converters, PHEV converters, related local and state government representatives, etc.

A New York Electric Vehicle Adoption Study conducted in January 2010 found that providing information and educational resources on Electric Vehicles can "dramatically increase interest" as well as identify unlikely EV purchasers.[36] During their study, they found that 21% of consumers were more likely to adopt an EV after being educated on their benefits, limitations, and reduced maintenance.

[35] Urban Grid Solar, www.urbangridsolar.com

[36] City of New York, New York Electric Vehicle Adoption Study, January 2010, available at http://www.nyc.gov/html/planyc2030/downloads/pdf/electric_vehicle_adoption_study_2010-01.pdf.

Impact of Education on Likelihood of EV Adoption



Source: New York 2010 Electric Vehicle Adoption Study and Related 2009 Survey

The New York study mentioned above found three low-cost actions that have very high impact for likely consumer EV adoption rates: educating the users, providing information on charging, and recognizing early adopters.

Vehicle Efficiency Comparisons

Vehicle efficiency comparison should be provided by OEMS. This information will eventually be available at the Environmental Protection Agency's Fuel Economy website: http://www.fueleconomy.gov/feg/sbs.htm.

Major stakeholders were solicited to determine the greatest hurdles for education. Additionally, input from other relevant organizations was used to ensure that their needs and that of the general public are also adequately met. It is expected that home and public charging stations, range anxiety, EV benefits, limitations, and maintenance will need to be addressed in EV education.

A list of related educational materials was identified and developed that will assist in responding to stakeholder education challenges, in addition to countering the most common objections and barriers of electric vehicle adoption among the public and other users. It is anticipated that some of this information may be specifically of interest to early adopters and those who may otherwise be early adopters, but lack certain information.

Examples of Relevant Educational Materials Gathered

Department of Energy Electric Vehicle Web Page:

This website was recently updated by the U.S. Department of Energy and contains comprehensive and newly updated information about modern electric vehicles: http://www.afdc.energy.gov/afdc/vehicles/electric.html. This represents the single best resource available for comprehensive electric vehicle information.

The U.S. Department of Energy will release a new Electric Vehicle fact sheet in the spring of 2011. Once released and reviewed, this document can be used at future events and will likely serve as an excellent resource.

Acronym Guide/ Glossary (based on information from several sources)[37][38][39]

This document, attached as Appendix 7, provides a listing of key vocabulary and acronyms for electric vehicles and infrastructure. This information can serve as a reference for individuals reading this document and considering the purchase of electric vehicles and/or the installation of charging infrastructure. An additional glossary for electric and alternative fuel vehicles is available at http://www.afdc.energy.gov/afdc/glossary.html.

The document available at the following website provides an educational summary of emissions information for electric vehicles and the savings versus conventional vehicles: http://www.eaaev.org/Flyers/images/low%20resolution%20(online)/eaaflyer-autoemissions.pdf.

User Testimonials

It is suggested that user testimonials be captured and published electronically and through social media in Virginia. These testimonials can illustrate the ease of use, ease of charging, and safety features or acceleration power of an electric vehicle.

List of Tax and Other Incentives

In addition to the incentives listed in the incentives section of this document, a listing of tax and other incentives is available online from the U.S. Department of Energy. This listing includes both federal and state laws and lists relevant Virginia laws once they are passed by the legislature: http://www.afdc.energy.gov/afdc/laws/.

Battery life information

General Motors and Nissan have eight year 100,000 mile warranties on their batteries. [40]

Owner Cost Comparison

While initial vehicle cost may be high for early electric vehicle purchasers, fuel costs will be considerably lower compared to gasoline. Nissan estimates that fuel for an internal combustion engine car would cost the owner 12 cents/mile over 15,000 miles, or $1,800 worth of gas (assuming 25 mpg and gas for $3/gal). An EV owner would pay just 2.6 cents/mile, or $396 (average $.11/kWh). Gas would have to be $1.10/gal to be a cheaper fuel than electricity at those home refueling rates.

---

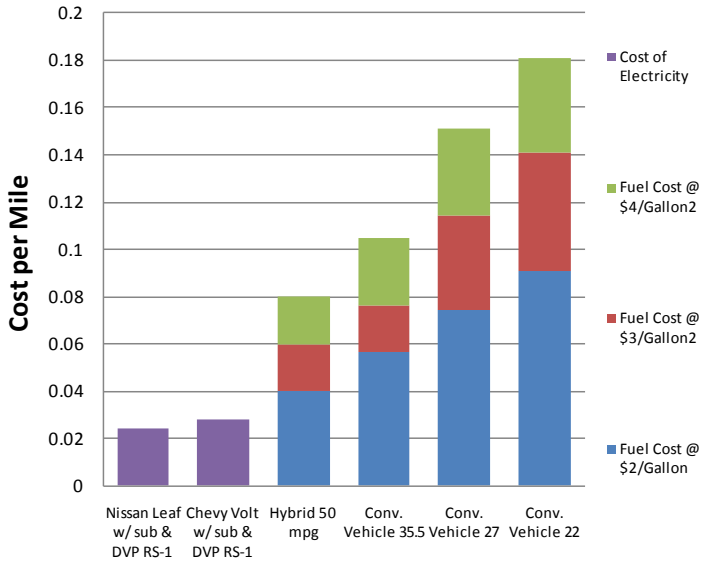
[37] EVBeat.com Wacky World of Electric Vehicle Acronyms, March 20, 2009 http://www.evbeat.com/blog/the-whacky-world-of-electric-vehicle-acronyms/.

[38] EVSource.com Electric Vehicle Abbreviations & Acronyms, December 7, 2009 http://www.evsource.com/articles/abbreviations.php.

[39] Electric Auto Association, EV Glossary, 2009, http://www.eaaev.org/Info/eaaglossary.html.

[40] Motor Trend, Nissan Leaf Battery Warranty Matches Volt's, July 27, 2010 http://wot.motortrend.com/6672119/green/nissan-leaf-battery-warranty-matches-volts-car-available-in-december/index.html

Fuel Cost

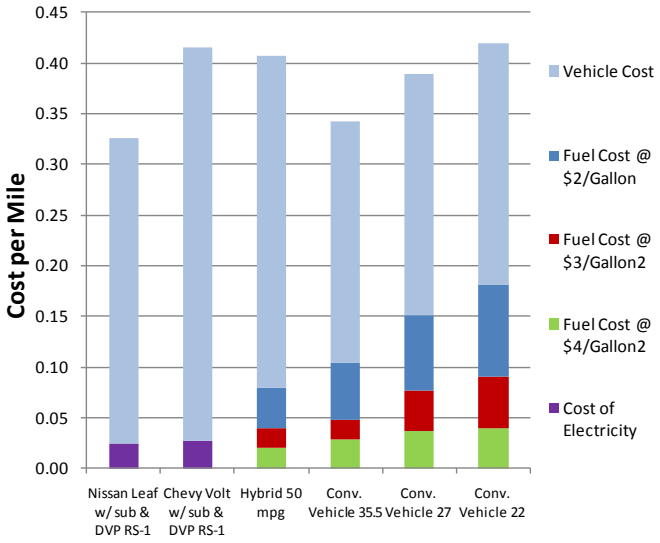


PHEV's are 50% less expensive to fuel even at low gasoline prices.

***Note: Average Va. Electric Rate of 11.2 cents per kWh.**

Source: Dominion Virginia Power

Total Cost



PHEV's with existing tax subsidy are price competitive.

***Note: 1) 7 year life, no maintenance cost, and 12K Miles/year**
2) PHEV40: $32.5k ($40k – $7.5k tax credit), Hybrid (Prius): $27.5k, Conventional (Corolla): $20k. Electric Rate: Average VA 11.2 c/KWh

Source: Dominion Virginia Power

Public Demonstrations at Events

Over the coming years, it will be helpful to advance a series of show-and-tell presentations at public events. These road shows and ride and drive events can be planned for car shows, government meetings, clubs, schools, science and environmental and transportation groups, and meet and greet initiatives at public charging stations. Electric vehicles will be displayed at the 2010 Governor's Energy Conference, and at two separate National Alternative Fuel Odyssey Day events in Virginia.

As funding is available from partner organizations, visible charging signage and charging location pamphlet information will be useful to capitalize on highly visible use of EVs, PHEVs, charging stations, and related equipment.

Basic Media and Educational Talking Points

An initial EV talking points document was developed in coordination with Virginia Clean Cities. This document is attached as Appendix 6.

Regional Resources

The National Alternate Fuels Training Consortium (NAFTC) is developing first responder curriculum for a number of alternate fuels, including electricity. NAFTC has designed a variety of four hour workshops for first responders that specifically address several alternate fuels, including electric vehicles. Through the NAFTC workshops, Tidewater Community College and James Madison University are likely starting locations for these trainings.

James Madison University's Alternative Fuel Vehicle Lab (AFV) is dedicated to helping people understand the depletion of global oil reserves and impending challenges associated with the inevitable loss of oil. To facilitate the transition to clean, renewable energy alternatives for the transportation sector, the AFV has engaged students with the design and construction of a number of different Alternative Fuel Vehicles, including biodiesel, ethanol, hydrogen, and electric vehicles. The AFV views electric vehicles as one of the most viable options for addressing oil concerns, because they can utilize the existing grid infrastructure for home/office charging, electric motors are well-developed and robust, and battery technologies are advancing rapidly. Electric vehicles also offer the potential to integrate with clean, renewable energy generation strategies such as wind, hydro, solar, as well as tradition electricity generation methods like coal and nuclear. Some of our successes with electric and electric-hybrid vehicles include an all-electric land-speed record setting motorcycle, an all-electric pickup truck conversion for the Shenandoah National Park, an all-electric commuter scooter for in-town applications, and experience with several commercially-available hybrids.

J. Sargeant Reynolds Community College has received funding through the American Recovery and Reinvestment Act for a project for EV conversions and technician training. Additional workshops can be held in coordination with the Green Jobs Alliance in Hampton Roads.

Key partners like NAFTC, JMU, J. Sargeant Reynolds, the Virginia Municipal League, and other engaged groups are of vital importance to educating and advancing outreach efforts. Utilizing their resources and keeping them engaged will remain a primary goal of this group.

Path Forward

The Department of Energy and Virginia Clean Cities are both integral partners and are well-placed in terms of outreach and education. Both are willing to engage stakeholders around the Commonwealth and disseminate information through a variety of forums. Specifically, information will be managed through a website developed with EV stakeholders to host EV resources including listings of parking decks with special EV parking, charging station locations, charging station permitting and installation resources, tax credit information, and contact information. This information should be supported as long as funding from public and private sources is available. If funding or partners are identified, other possible initiatives include developing brochures, TV and radio PR spots, billboards, and other traditional avenues in terms of public relations and education.

Incentives

Incentive Selection Considerations

When selecting incentives to pursue, one must take into account several factors including the proposed incentive provider, regional focus, and the targeted adopter category.

Basic Considerations

When considering possible incentives, care should be given to addressing basic concerns. The primary concern with electric vehicles will be range anxiety. How far can I go on a charge? Where will I be able to recharge? How long will recharging take? What is the perceived range need for early purchasers? Incentives that reduce range anxiety should be included (such as free/reduced standard combustion vehicle rental or free/reduced public transportation). Note that the range need may only be local in nature.

Another concern for potential adopters will be vehicle maintenance and disposal costs. Automobiles tend to be an individual's second largest purchase besides a home. Many in the early adoption categories are often renters, making a vehicle purchase their costliest purchase. There are many unknowns surrounding the maintenance of EVs and disposal costs, particularly with batteries. Incentives should seek to address and reduce these concerns.

The complexity of charging station installation must also be considered. Installation of a charging station could require various permits and the involvement of a variety of third parties including the electric utility, installation contractors, and local building inspectors. Attention should be given to incentives that streamline and simplify this process.

Adopter Category Targeting

Under the Diffusion of Innovation theory, there are five categories of adopters in the adoption curve. These include Innovators, Early Adopters, Early Majority, Late Majority, and Laggards.[41] To be effective, incentives must be targeted at the front-end of the adoption curve, to the Innovators and Early Adopters, because they determine the rate of market saturation for new innovations. Incentives may also benefit the Early Majority, but should not be the primary focus when selecting incentives.

Innovators are the first individuals to adopt an innovation. Innovators are willing to take risks. They tend to be youngest in age, have the higher social status, and have greater financial lucidity.

Early Adopters are the next category on the adoption curve. Early Adopters tend to have the highest degree of opinion leadership among the other adopter categories. Early adopters are typically younger, have a higher social status, have more financial lucidity, and have more advanced education.

Incentive Provider

When analyzing the feasibility of an incentive, we must be cognizant of party impacted by the incentive. For example, in many metropolitan areas, parking is primarily provided by privately-owned parking garages. As these are for-profit entities, they are driven solely by commercial interests. In order for them to provide an incentive to EV adoption, there must be financial reward associated with it, to compensate for installation costs.

The most likely incentive providers are those with a vested interest in the adoption of EV technology. These include, but are not limited to, the federal government, automobile manufacturers, charging equipment manufacturers and retailers, electric utilities, state and local government, environmental and clean air organizations.

Regional Focus

Regional targets must be considered when prioritizing incentives. EV manufacturers have placed priority on certain regions, including Northern Virginia. Incentives should match these manufacturer-selected regional preferences. Developing incentives targeted at other areas of the Commonwealth would be less successful in achieving their goal.

In order to be effective, targeted incentives must meet one or more of the following criteria:

- Motivate Innovators and Early Adopters in the adoption curve (see below).
- Reduce barriers/anxieties surrounding the purchase and ownership of Electric Vehicles and charging stations.
- Provide an economic incentive for adoption (as in the case of the "re-sale" of electricity).

[41] Rogers, Everett, *Diffusion of Innovations* (Everett Rogers, 1962)

- Match the roll-out of EV technology regionally as defined by EV manufacturers.
- Be revenue neutral to the Commonwealth or result in an ultimate revenue offset.
- Be practical and feasible.

Existing Incentives

The Virginia Get Ready planning process included a wide review of potential incentives. This review rated and considered incentives based on feasibility and impact. A listing below of existing incentives illustrates the Commonwealth's existing emphasis on electric vehicles.

- Federal Tax Credit of $7,500 for new electric vehicle. This existing IRS tax credit allows vehicle dealers to take the tax credit in the event of sales to nonprofit or untaxed government agencies.
- Through December 31, 2011, qualified plug-in electric vehicle conversions are also eligible for a tax credit for 10% of the conversion cost, not to exceed $4,000. Additionally, a tax credit of up to 10% of the cost of qualified low-speed electric vehicles, electric motorcycles, and three-wheeled electric vehicles, not to exceed $2,500, is available through December 31, 2011.
- There is a 50% federal tax credit up to $50,000 for installing alternate fuel infrastructure (through the end of 2010).
- Access to HOV lanes without passenger restrictions. The Virginia Clean Special Fuel Vehicle Plate should be updated to explicitly allow new electric vehicles. Due to the numerous plate designs, it may be worthwhile to pursue a similarly designed electric vehicle plate to accomplish this task.
- Complimentary charging. Because vehicles are unlikely to stick around at a retail or government facility, some businesses and some government facilities offer free charging to visitors or customers.

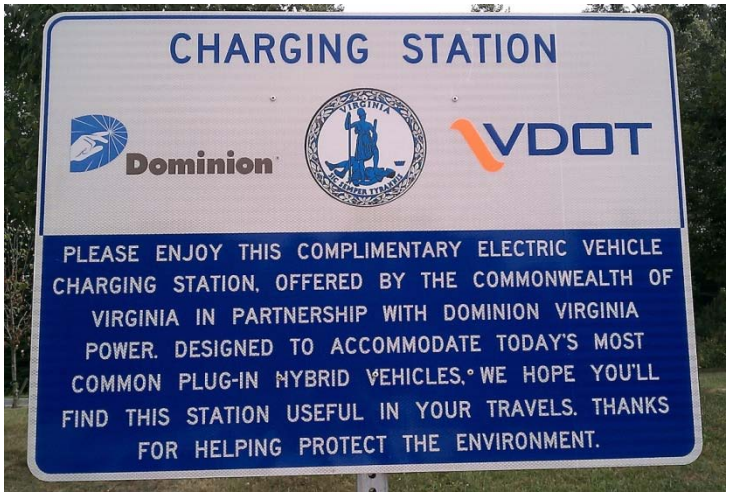


Photo credit: Virginia Clean Cities

- Special EV Parking Areas. Adding special parking such as charger only, or clean fuel vehicle only parking in private, public, and government facilities can provide an easy incentive. Examples of this are Virginia's I-64 New Kent westbound exit signage as well as Raytheon's offices and several Best Buy locations in the Commonwealth. This parking signage also provides builders with green building credits.

Photo credit: Virginia Clean Cities

Virginia can spur more rapid adoption of electric vehicles by advancing new long-term incentives. The Virginia Get Ready Roundtable members will begin to enhance existing incentives and pursue additional ones. For financial incentives, it would be advisable to explicitly ensure that utilities, non-profits, and government entities are entitled to something equivalent to tax credits in order to promote realistic early adoption. This would be similar to the federal tax credit flexibility that allows dealers to collect tax credits on behalf of tax free entities.

Policy Considerations

Historically, the realms of electric power and vehicular transport have been largely separate. As these two realms merge, numerous public policy issues will continue to emerge and will give rise to important dialogue regarding the best public policy responses. Electric vehicles exemplify a disruptive technology that will change the way we think about vehicle transportation. If we take the right policy approaches, they have the potential to provide significant economic and environmental benefits to society. One important policy issue revolves around the regulation of electric sales.

In the Commonwealth of Virginia, only public utilities are authorized to sell electricity at the retail level, except in some limited cases. In other states across the country, including states that fully regulate retail sales of electricity and those that allow retail competition for the sale of electricity, laws regarding the retail sale of electricity vary widely. The issue regarding whether the provision of electric vehicle charging services constitutes the "re-sale" of electricity subject to state regulatory oversight is likely to be resolved on a state by state basis. To date, the only state in which this issue has been fully addressed is California. In a proceeding before the California Public Utilities Commission (CPUC) in July 2010, the CPUC determined that it would not regulate the resale of electricity used for transportation

as long as electric vehicle charging service providers purchase the electricity from a regulated public utility or other electricity service provider authorized to engage in retail electricity sales in the state.

The CPUC initiated the above-referenced proceeding as a result of a California state law that required the CPUC to implement policies to overcome barriers to the widespread deployment and use of plug-in hybrid and electric vehicles. The CPUC also urged the California state legislature to codify its July decision in order to remove additional barriers to the adoption of electric vehicles and to provide statutory certainty. Similarly, the Virginia Project Get Ready stakeholders recommend that Commonwealth of Virginia also consider the need to address these same issues through appropriate legislation. Other related policy issues include, but are not limited to:

- How utilities will approach rules regarding services to support their customers' use of electric vehicles in the residential, commercial, and industrial sectors and how associated costs should be allocated and recovered including adopting line extension policies that reflect the emerging nature of the industry;
- The interface of charging service providers with utilities and end-use customers;
- How municipalities will deal with building codes, permitting, vehicle parking and charging;
- A mechanism to replace the gas tax for electric vehicles in order to adequately support the Highway Trust Fund, used to pay for road and bridge repairs;
- The role that States, including the Commonwealth of Virginia, should play in ensuring that standards, technologies, and safeguards related to electric vehicles are established in a consistent and harmonious manner across the region; and
- Whether electric vehicle users should be required to bear all costs of electric vehicle infrastructure when the benefits of electric vehicles (cleaner air, EPA compliance, and energy independence) will be enjoyed by all citizens.

Recommendations

In the interest of attracting public comments and public vetting of recommendations, a comment form is available publicly for 6 weeks from the launch of this initial plan at http://www.VirginiaEV.org. Appendix 9 also provides a listing of short, medium and long-term recommendations from the Virginia Project Get Ready Group. All interested parties can submit additional recommendations or comments which will be reviewed and may be endorsed later by the Governor.

Appendix 1: Process Time for Other PGR Groups

	Houston	Raleigh
Overall Wait Time		
Past	~48 hours	n/a – no process in place
Current	48 hours	1-2 days
Goal	24 hours	1-2 days
"Best" Practice Process	Current: Owner purchase EV, Owner setup with electrical contractor or contacts on own, contractor requests permit ONLINE (has within 15 minutes), completes installation, requests inspection, inspector comes within 24 hours to approve	Current: Request inspection up to until midnight of the day before; inspectors know to keep these the highest priority
Permit: Same Day Online or Fax?		
Residential	Yes, online in 15 minutes	Working on e-permit process
Commercial	Yes, online in 15 minutes	Must get right-of-way permit for an additional $74
Permit: Same Day Over-the-Counter?		
Residential	Possible, encouraged online	Yes, one unit, same day
Commercial	Possible, encouraged online	Yes one unit, same day
Who Requests?	Electrical contractor/installer	Homeowner, contractor, installer
Cost	$35-$45 plus the cost of the plan review, if necessary	$74
Inspection		
Yes/No	Yes	Yes
Cost	Included in permit price	Included in permit price
Plan Required: Residential	No	No
Plan Required: Commercial	Yes	Required for multiple commercial units
New Construction	n/a	Have considered it; LEED buildings are beginning to lay the conduit
Working with Localities	Relatively easy; easier with localities closer to the urban areas which are preparing for the vehicles; relatively receptive and positive towards preparing for the process	In the beginning, it was difficult to get buy-in from contractors and inspectors, but beginning to move forward as EVs hit the area

Recommendations and Challenges	Could look at Portland attempt at "bulk sticker" permitting, random inspection process; Houston currently worked to reduce to 24 hours IF installation is complete by noon, inspector should arrive by the end of the day	Public and internal education process is key; online information; Marketing and Education group with Project Get Ready; working with Progress Energy and Duke Energy – trying to streamline steps and create a booklet to underscore the process; information guidelines; Developmental Services and Permitting Department creating a How To video for installation
Contact	James Tillman James.tillman@cityofhuston.net Office phone: 713.837.9615	Nelson Daniels Nelson.Daniels@Raleighnc.gov Office phone: 919.996.4255

Appendix 2: Survey of Virginia Localities Permitting Processes

[*Script for survey*]: "Thank you for your time, my name is XXX and I am working with Virginia Clean Cities to investigate the current standards and permitting process for installing electric vehicle recharging systems. I am hoping I could ask you a few questions to explore how we could streamline the existing process. We are interested in learning the distinctive permitting procedures for installation of EV recharging systems as they apply to a) residences, b) commercial buildings, and c) municipal buildings (both new and existing)."

1. What type of permit is currently required for installing a 240V electric vehicle recharging system?
2. Which agencies are involved in the permitting process?
3. Who can request the permit? (Homeowner, licensed contractor, authorized agent, etc.)
4. What is the current process for obtaining a permit(s)?
5. What are the costs involved in the permit process?
6. Approximately how long does it take to secure the permit(s)? Can it be done online, or over the counter?
7. Is an inspection required? Cost?
8. Is an electrical plan required for all installations? Or for major, complex installations?
9. Regarding your current procedures for electrical permitting, what do you think has worked well in your city/county's permitting process? What do you think has not worked well?
10. Purchasers of plug-in vehicles, both for personal and for commercial use, are likely to be particularly interested in being able to get charging equipment installed in their homes or places of business very quickly in conjunction with the purchase, since the vehicles would have extremely limited utility without it. What would you see as possible in terms of a streamlined permitting process? Any recommendations?
11. If electric vehicles become widely accepted, some measures could be taken in building construction today that would greatly simplify later addition of charging equipment for these vehicles. What would be the process if your jurisdiction were to decide to put in place a regulation requiring any new home building, or certain major renovations, to provide electrical service that could support 240V charging?
12. Can we list you as a contact in the process?

Survey results follow and are available at **http://www.VirginiaEV.org**.

VA Get Ready Existing Locality Procedures

R= Residential Installations; C= Commercial Installations

*adapted from FoE 2010 CA Study

*Information included here was received from the parties listed as contact points; this is provided for exploratory purposes and not intended to be the definitive process for each locality.

	Permit				Costs		Time for Permit Approval					Inspection Required		Plan required		Recommendations	New construction	Contact
							Same day online or fax?		2 day over the coun		Other							
Locality	Type	Agencies	Who Requests	Process	R	C	R	C	R	C		Y/N	Cost	R	C			
Fairfax, Northern Virginia	Electrical, Building permit if a concrete pad is needed	Dept. of Public Works and Environmental Services	Homeowners, licensed contractor and authorized agent	over the counter, fax, online by end of 2010	$85	$85	same day	same day	Y	Y		Y	included in permit	N	Y	Can obtain a permit in 20 minutes at the right time, feels the process is pretty streamlined especially considering the upcoming switch to online permitting	Counties and towns don't have any authority, so there's nothing they can do	Brian Foley 703-324-1842
Loudoun, Northern Virginia	Electrical	Building and Development	Homeowner, licensed contractor, authorized agent	Over the counter	$70	$95	N	N	N	N	10-15 days potentially	Y	Inspection before wiring is covered up, the cost is covered in permit	N	Y		Counties and towns don't have any authority, so there's nothing they can do	Joe McGard, 703-771-5762
Arlington County	Electrical, Zoning	Inspection Services, Zoning	Home Owner, Licensed Contractor	over the counter	$120	$120	N	N	Y	Y		Y	Cost is included in permit fee	N, for single family homes	Y			James Arjani Chief, Inspection Section 703-228-3875
City of Richmond	Electrical	Residential permits and commercial permits-Dept. of Planning & Development Review (DPDR); Permits for installation of charging stations in public- DPDR & Dept. of Public Works for encroachment permit & if it involves historic building then Commission of Architectural Review (CAR)	Property owner, licensed contractor and authorized agent of owner	Request permit from Bureau of Permits & Inspections in DPDR; Can submit application via fax, mail or over the counter	Residential: $0-$2,000 = $63; over $2,000 = $63 + $6.064/per $1,000 + 2% state surcharge	Commercial: $0-$2,000 = $191; over $2,000 = $6.489/per $1,000 + 2% state surcharge	New permit IT process implemented by Fall 2011 that will enable online permit application and approval	New permit IT process implemented by Fall 2011 that will enable online permit application and approval	Same day for over the counter	2-3 days unless other reviews needed		Inspection is required at rough in and final work	Cost is included in permit fee		Plans required for commercial projects that exceed $3,000 & for public installation projects	City will have a new permit IT process implemented by Fall 2011 that will enable online permit application and approval. Worked well: same day permit for walk-ins; improvements: New permit IT process will enable online applications and other improvements to educate community ahead of time re: PHEVs and permit process; post information on city website, meet with local electrical contractors/trade associations	Needs to go through Virginia General Assembly to get Virginia Statewide Building Code changed	William.eddleton@richmondgov.com
Henrico, Richmond	electrical	Building Inspections	Owner, Contractor, Engineer	Application on line or from office	$4/1000 Plus $68	$4/1000 Plus $68	N	N	Y	N	Typically 3-4 days	Yes	Included with permit fee	N	Y	Have complete plans at application	Would have to go through Virginia General Assembly	Dave Humphry @804-501-4365
City of Norfolk, Hampton Roads	Electrical	Bureau of Building Safety	Contractor/Electrician	Over the counter permit; commercial = 10 days; residential = 5 days	Residential: around $100;	Commercial: varies	Same Day, Fax OK	Same Day, Fax OK	Y	Y		Y	Included in permit	N	N	We are familiar with the technology and prepared to embrace the demand for installations.	State adoption of amendment to simplify the process would be the best way.	Lynn Underwood, Building Official;
Albemarle County	Electrical	Department of Community Development: Central Operations Office, Inspections Office, Zoning Office, and sometimes Architectural Review Board office	Property owner, property owner's agent (including contractor)	Residential: applicant comes to office and applied for permit; pays fee and permit is issued immediately; Commercial: applicant needs to bring two schematic wiring diagrams, two copies of manufacturer's literature on specific product, two copies of site plan or equivalent, and pay fee.	$30 per inspection (1-2 inspections needed); +3% state surcharge	$30 per inspection (1-2 inspections needed); +3% state surcharge	N	N	immediate over the counter	up to 10 days		Y	included in permit	N	Y	Typically a smoother process if professional responsible for the installation applies for the permit (easier to answer questions); "The residential installation process cannot be made faster. The commercial installation process is very efficient, with any delays usually being caused by the need to gather information from the applicant. Having the applicant present a well-prepared application package is the best recommendation."	Needs to go through Virginia General Assembly to get Virginia Statewide Building Code changed	Jay Schlothauer, Director of Inspections, 434.296.5832
City of Charlottesville	electrical	Neighborhood Development Services	home owner, owner, or contractor	Applicant must come into	$100	$100	N	N	Y	Y		Y	included in permit	N	N		Must wait for law change	Jim Tolbert, Dir. of Neighborhood Development Services, tolbertj@charlottesville.org

Appendix 3: E-permitting Information from Oregon

E-permitting

Purchasing permits on line through BCD's e-permitting program is available to electrical contractors in most areas affected by the rollout of the Nissan Leaf demonstration project. The inspection of installations of Electric Vehicle Supply Equipment, (EVSE), is the same whether the permit was purchased online or over the counter. Below is a list of the local jurisdictions that are currently participating in the e-permitting program as of 2/1/10:

- Portland, Lake Oswego, Troutdale
- Washington County
- Clackamas County
- Yamhill County
- Marion County
- Salem
- Corvallis
- Lebanon
- Lane County

Use of Minor Installation Labels

Currently, the minor label program can be used by electrical contractors for the installation of branch circuits up to 30 amps at 240 volts. Given this amperage limitation and the fact that the home-based EVSE will require a 40 amp 240-volt circuit, the division is investigating another avenue of allowing the use of a minor label for the installation of a 40 amp, 240-volt branch circuit and the connection of EVSE in one and two family dwellings, where the EVSE is in an attached garage.

The minor installation label program was developed and implemented for repair and maintenance activities, and expanded to include electrical installations that are simple and straightforward. The installation labels are about a tenth the cost of a regular permit, and only a tenth of the installations get inspected.

Nine out of ten installations done under the minor label program will not be inspected to be sure that the existing service equipment has adequate capacity for the additional load of the EVSE. Older homes with 60 or 100 amp electrical services, and all-electric homes with no natural gas service may not have the capacity to safely supply the existing loads and the additional load. It may be prudent to require 100% inspection of the first hundred installations.

Source: Dennis Clements, Chief Electrical Inspector, Oregon Building Code Department, 2/12/10

Appendix 4: Sample EVSE Installation Guide

What should I do prior to purchasing a Plug-in Vehicle?

Work with an EV seller or EV charger provider, determine whether you want to install a Level 1 charger (less complicated installation but 8-14 hour charge time) or Level 2 charger (more complicated but 4-6 hour charge time). To save money on electrical rates while your electric vehicle charges, contact your utility company to determine what type of installation is required to set up best time-of use service. If the utility company indicates you need a second meter panel or a dual meter adapter to take advantage of lower electrical rates whiles your electric vehicle is charging, contact your city or county's building division to determine whether the agency allows such installation before proceeding. Have a private electrician inspect your home to determine whether you have sufficient electrical capacity for the type of EV charger installation you desire (Level 1 or Level 2). Obtain a cost estimate for electrical upgrade if required as well for other installation work that may be needed.

What kind of permit do I need to install an EV charger?

You need an electrical permit.

Do I need to submit plans with my permit?

No plan is required for simple EV charger installations that will not require trenching. For projects that do require trenching, plans will be required.

How do I apply for a permit?

Submit an application to the Building Department that identifies the property, lists the name of any person who will work on the project, and describes the proposed work in detail.

If plans are required, submit three sets of plans along with the permit application showing the following:

- Location of service
- Amperage (size of service)
- Service entrance conductor size and material
- Insulation type of the service entrance conductor
- Size and type of grounding conductor
- Number of new circuits and their use (if applicable)
- Wire size and type of any new circuits.

A separate "Plan Requirements" webpage (http://www.XXXX), describes plan requirements in greater detail and gives examples of how the various plans should be drawn up. If you are a homeowner and plan to submit the entire application yourself, we recommend that you first prepare preliminary plans and bring them to the Building Department counter so that we can review them. An informal meeting at this stage may save you considerable time and money later on. All applications, (with or without plans), may be submitted by homeowners or licensed contractors in person, by fax at XXX-XXX-***XXX, on-line at http://www.XXXX, or through the mail.***

Once I've submitted my EV charger permit application, how long will it take to receive my permit?

For permit applications without plans, permit issuance is immediate. Permits will be issued via the same method - in person, via fax, on-line, or by mail - that applications were received. Approval for permit applications with plans will take from one hour to XX days. Permits will be issued based on the request of the applicant (i.e. over the counter, via fax, on-line, or by mail).

How do I request an inspection of my project?

You can schedule an inspection by calling our 24- hour inspection phone line at XXX-XXX-XXXX or on-line at http://www.xxxx. Inspections are generally scheduled the day following the request, provided the request is made before 12 p.m. Otherwise, inspections are scheduled for the following day.

What fees must I pay?

The fee for a residential EV charger installations is XXXX. For commercial installations it is XXXX+.

Who do I contact if I have questions?

For questions regarding permit submissions, fees, and timing, contact the Building Permit Center:

Phone XXX-XXX-XXXX or via email at: XXXX@XXXX.

For questions regarding the plan review process, contact the Planning Department at: XXX-XXX-XXXX or via email at: XXXX@XXXX.

For questions regarding the inspections process, contact the Building Inspections Division at: XXX-XXXXXXX or via email at: XXXX@XXXX.

Appendix 5: Charging System Needs Analysis

EV Charging System Needs Analysis What Features Do I Need On My Charging Station?			
	What is it?	**Why do I want it or need it?**	**For Commercial Installations**
Level 1	120V @ 16Amps. Level 1 charging is the slowest method of charging, and it can be powered by standard home current. It will take at least 8-12 hours to completely charge the average EV. Figure 1 hour for each kWh of energy storage.	If you use your EV less than 35 miles a day, and you charge up each night at home, this may be all you need. A partial charge of 5 kWh will only take about 5 hours. Be sure that your EV can charge with 120 volts (Level 1), since some of the new EVs are made to charge only on 240 volts (Level 2).	Not recommended as a standalone installation, but should be considered if you already have a Level 2 station installed.
Level 2	240V @ 32Amps. Level 2 charging uses 240 voltss, which will be available in most homes. If you do not have 240 volts already in your home, be sure to find out about the expense of having it installed by your local electrician.	Your new EV may require Level 2 (240-volt) charging. Generally, Level 2 charging will take only half as long to charge your vehicle as Level 1. However, charging times will vary based on state of charge when the vehicle is plugged in, battery size, battery demand, etc. Most users will have Level 2 charging.	Level 2 is recommended with Level 3 for some applications as it becomes available.
Level 3	480V @ 100Amps. This is the "Fast Charge" option, and complete charging can be done in about 20 minutes (possibly less depending on what the manufacturer claims).	This is not recommended for typical home installation due to safety and cost issues.	Recommended for applications where very fast charging is required (filling stations, highway rest stops, some resort locations, etc.). It is the most expensive to install but offers the fastest charge available – 10 to 20 minutes in some cases.

Dual Mode Charging (120V & 240V)	120V and 240V simultaneous and consistent charging.	This can be useful if you may change vehicles and/or charge different vehicles in the future.	240V (Level 2) or Level 3 will be most popular at most commercial stations. Not a lot of 120V needs due to the longer charging times.
Indoor use or Outdoor Use	Indoor chargers are less expensive. Outdoor chargers are weatherproof, but the charger and the installation will be more expensive.	Ensure that indoor chargers are installed where they will not be in the way of foot traffic and the cord will also be safe.	Review access and expected use before selecting the charging station. A plain "black box" may not be suitable for a space in front of your main entrance, but might be fine in your underground parking lot.
Commercially Available	There are many new charging stations now announced. Ensure that the manufacturer does actually have units installed and ask for references that you can call to verify claims.	Do not trust a slick website on this. There are a lot of claims out there that must be verified.	*Consumer Reports* has not yet tested charging stations. Be caution of manufacturer claims or other claims that may be biased.
Safety and Compliance Standards	User authentication to obtain access to EVSE. Utility grade meters in ALL stations. Built in GFCI automatic re-closure after 2 minutes.	For private consumer home installation, it is probably best to ensure that the product is UL listed.	For commercial customers, a unit with a utility-grade meter is important, especially if customers may be charged for access or electricity.
Liability Issues	Primarily a commercial consideration, but should be considered at home if others will be using the chargers.	Not a major concern in most cases.	Does the unit have adequate protection by GFI and the ability to remotely notify the owner of a circuit breach, vandalism, or malfunction?
Data Management Reporting	Tracks GHG and fuel savings, allows fleet managers to track vehicle usage and real-time charging status, generate station usage reports.	Not as important for private consumers.	Evaluate your fleet needs for data collection. Consider possible federal incentives for greenhouse gas reduction.
Networking	Is the product wireless and accessible via Internet or cell phone? Can the unit software be upgraded remotely?	Can you access the unit by Internet or phone to notify you of any problems, or when your vehicle is completely charged?	Can you monitor multiple units in your installations for problems, usage, etc.?

Ground Fault Protection	The unit should be ground fault protected, and should shut off power in the event of high current draw or short circuit.	Do you want a home unit with automatic restart or not? Nice to have but not critical for home use.	Can the unite be restarted by remote (wireless) control? This can be very important if you do not have personnel located close to the unit at all times.
Sales Forces	Many suppliers have local sales representatives. Others may have different marketing channels, including Internet sales.	You will need a local electrician to install the unit in your home. You may not require a local sales agent.	Commercial customers may require more support, including site review and consultation with a local sales agent.
Payment Collection	Can billing be handled through an automatic billing process, which allows station owners to pay for access to stations? Revenue generating stations that allow for solid business ventures with viable business models. Multiple forms of payment may include credit card via phone or contactless swipe.	Not really applicable for private owners.	This could be an important consideration for commercial buyers. Remember future business considerations.
Driver Benefits	Drivers access their account from anywhere in the world. iPhone app is available. Blackberry and other smart phone applications are in development. Can you search for stations along a planned route, location destinations, and request stations at frequented locations? Alert when vehicle is fully-charged, stopped charging, or when time has expired (if there are time restrictions on parking space). These are added features of having a networked charging station.	Many charging units now have some or all of these features. Range anxiety is much reduced if you can access information about where you can pick up a charge on your vehicle, which hotels, restaurants, etc., have charging stations and are they in use?	These features may be as important to fleet owners as they are to other locations. For hotels, restaurants, and other destination charging locations, this may be a significant consideration.

Appendix 6: Electric Vehicle Talking Points

Electricity can be used to power electric and plug-in hybrid electric vehicles that store electricity in an energy storage device, such as a battery. The electricity powers the vehicle's movements via an electric motor.

Plug-in vehicles are here, and more vehicles arrive from major manufacturers in 2011.

EVs like the Nissan Leaf or Tesla Roadster are all-electric vehicles whose batteries must be replenished by plugging into an electrical source (Leaf 100 mile range, Tesla 220 miles). Extended Range EVs like the Chevy Volt use both a battery that holds an electric charge and an internal combustion generator to recharge (40 miles electric range, additional 300 mile range through electricity powered by E85 or gasoline).

There are several advantages to most Battery Electric Vehicles (all-electric):

- Zero tailpipe emissions such as CO2, ozone, particulates, or other harmful pollutants – emissions produced in the generation of electricity for battery recharging are significantly lower than gasoline use on roads; Additionally, 100% renewable energy can be used to eliminate emissions
- Lower fuel and operational costs (less complexity, no gas engine, no oil changes)
- Recaptured energy from regenerative braking
- Robust electric grid infrastructure exists nearly everywhere in the U.S.
- Energy security by displacing imported petroleum with domestically generated electricity

An internal combustion engine car fuel would cost the owner 12 cents/mile over 15,000 miles, or $1,800 worth of gas (assuming 25 mpg and gasoline at $3/gal). An EV owner would pay $0.026/mile, or $396 (avg. electricity rates of $0.11/kWh). Gas would have to be $1.10/gal to be a cheaper fuel than electricity at those rates. (Source: Nissan)

95% of the U.S. population drives less than 100 miles a day (Source: Nissan). 78% of U.S. drivers commute 40 miles or less than per day (Source: GM / USDOT 2003 Household Survey).

Chargers have been designed to be highly technical, communicate with vehicles and with cell phones, and to be safe and standardized.

There are 3 levels of charging. Level 1 120v (1.2 kW) charging (15am to 20amp) standard household outlet – charges a vehicle in about 8 hours. Level 2 is 240V (3.3kW-6.6 kW) charging (20amp to 40amp) charges PHEVs in about 3 to 5 hours. Level 3 or DC Fast

Charging allows charging to occur in 30 minutes to an hour, but North American DC Fast Charging standards are still a work-in-progress.

Residential charging infrastructure is the top priority, followed by the workplace and public charging.

Electric vehicles represent an opportunity to create new jobs, new educational areas of expertise, and a new domestic energy market in the future.

Including the Recovery Act and recent private ventures, there have been considerable investments in improving battery technology for lower cost, increased density, and extended durability. This research and investment will need to continue to make electric vehicles more affordable.

Many federal and state incentives encourage the use of electricity as an alternative fuel:

- The qualified plug-in electric drive motor vehicle tax credit up to $7,500 is available for the purchase of a new qualified plug-in vehicle. This tax credit applies to vehicles acquired after December 31, 2009. (Reference Public Law 111-5, Sections 1141-1144, and 26 U.S. Code 30D)
- Through December 31, 2011, qualified plug-in electric vehicle conversions are also eligible for a tax credit for 10% of the conversion cost, not to exceed $4,000. Additionally, a tax credit of up to 10% of the cost of qualified low-speed electric vehicles, electric motorcycles, and three-wheeled electric vehicles, not to exceed $2,500, is available through December 31, 2011.
- There is a 50% tax credit up to $50,000 for installing alternate fuel infrastructure (through the end of 2010).
- Coulomb Technology (Chargepoint America) and Ecotality (The EV Project), both supported by the Department of Energy through the Recovery Act, offer free chargers to consumers in certain localities.

Virginia Get Ready Talking Points:

Virginia drafted a plan to facilitate the roll-out of electric vehicles. This plan involved the input of nearly 100 individuals and dozens of relevant organizations. state and local government entities, fleets, universities, utilities, civic organizations, vehicle manufacturers, and businesses were represented.

EVs represent an economic opportunity. So far in 2010, 84 new jobs and $23.5 million in new investment have been announced in the electric charger and battery component sectors in Virginia.

The objectives of Virginia's efforts are to establish Virginia as a leader in the adoption of electric vehicles in order to reduce vehicle emissions, increase energy independence, and generate positive economic development for the Commonwealth.

Our goal was to present an initial Virginia "electrification plan" detailing:

- How to overcome potential barriers associated with the adoption of plug-in vehicles and charging infrastructure specifically related to codes, standards and processes;
- A communication strategy to educate appropriate partners, stakeholders and the general public;
- The potential incentives (monetary, nonmonetary, upfront and long-term) to encourage businesses and individuals to purchase plug-in vehicles;
- The issues and tasks necessary to the installation of a charging infrastructure, from the technical to the managerial.

Appendix 7: Glossary of Terms and Acronyms

AC (Alternating Current): a type of electric power commonly found in households or businesses where the electric charge constantly and cyclically reverses directions.

AFV (Alternative Fuel Vehicle): a vehicle that runs on any form of alternative fuel, whether it is electricity, solar energy, ethanol, biodiesel, etc.

Amperage: the strength of an electrical current measured in amperes ("amps").

BEV (Battery Electric Vehicle): a battery operated electric vehicle powered by electricity stored in batteries (also referred to as all-electric vehicle). Includes: Toyota RAV4 EV, Honda EV Plus, GM EV1, Ford Ranger EV, which are discontinued. Also include Tesla Roadster, Nissan Leaf, and Ford Transit Connect.

DC (Direct Current): a type of electric power commonly found in batteries and solar cells where the electricity charge flows in one direction.

EV (Electric Vehicle): a vehicle comparable to the conventional gasoline-fueled vehicle, except that refueling is done through electricity and stored in a battery instead of a tank. Power is then transmitted to the wheels via an electric motor, rather than a traditional Internal Combustion Engine.

EVSE (Electric Vehicle Supply Equipment): equipment used in charging electric vehicles.

E-REV (Extended Range Electric Vehicle): an electric vehicle with a back up source of power such as gasoline or e85 ethanol. Includes: Chevy Volt

HV (Hybrid Vehicle): a vehicle that uses two or more power sources, usually with one fuel source such as gasoline, the other often a form of electricity stored in a battery.

Instantaneous Demand: the maximum electric demand at the instant of greatest load.

kW (Kilowatt): a unit of power measurement; one watt is equal to one joule per second; 1,000 watts equal one kilowatt.

kWh (Kilowatt-hour): a unit of energy measurement equal to one kilowatt acting for one hour; frequently used as a unit of electrical consumption by which domestic energy use is measured

Li-ion (Lithium Ion): a rechargeable battery technology that uses the mineral lithium as a catalyst against various other materials to store and then deliver electrical energy.

NEV (Neighborhood Electric Vehicles): a battery-charged EV with a given amount of speed of up to 25 mph in designated neighborhood areas. Great for small communities. Includes: Columbia ParCar Mega, Dynasty IT, GEM E4, Miles ZX40S, Miles ZX40ST, and Zenn Standard.

NiMH (Nickel Metal Hydride): a rechargeable battery technology that uses the mineral nickel and a hydrogen-storing alloy to store and then deliver electrical energy.

PHEV (Plug In Hybrid EV): a vehicle with the same electric engine as a hybrid but with batteries that are recharged by plugging into an electric power source.

V (Voltage): a measure of electric potential, which is the condition that causes electric energy to flow; measured in volts

ZEV (Zero Emissions Vehicle): a vehicle that produces no tailpipe emissions, no evaporative emissions, and no emissions from gasoline refining or sales, according to California's Air Resource Board, which also produced the standards for the SULEV and PZEV.

Appendix 8: Listing of Virginia PGR Stakeholders

Organization	Name	Office	Email
State Government Entities and State Fleets			
Department of Mines, Minerals and Energy	Robin Jones	804.692.3224	Robin.Jones@dmme.virginia.gov
Department of General Services	Mike Bisogno	804.367.6526	michael.bisogno@dgs.virginia.gov
Secretary of Transportation	Sean Connaughton		
	David Tyeryar, Deputy Secretary	804.786.8032	David.Tyeryar@governor.virginia.gov
Department of Transportation	Larry Maready	804.786.0564	larry.maready@vdot.virginia.gov
Department of Motor Vehicles	Matthew Martin	804.367.1875	matthew.martin@dmv.virginia.gov
Virginia Economic Development Partnership	Mike Lehmkuhler	804.305.3433	mlehmkuhler@yesvirginia.org
Department of Housing and Community Development	Emory Rodgers	804.371.7151	emory.rodgers@dhcd.virginia.gov
Motor Vehicle Dealer Board	Bruce Gould	804.367.1100 x3002	bruce.gould@mvdb.virginia.gov
Department of Energy	Linda Bluestein	202.586.6116	linda.bluestein@ee.doe.gov
Fairfax County	Dave Duval	703.324.3554	Dave.Duval@fairfaxcounty.gov
Loudoun County	Najib Salehi, Energy Manager	703.737.8442	najib.salehi@loudoun.gov
Arlington	Chris Alison	703.405.0328	callison@arlingtonva.us
City of Richmond	Alicia Zatcoff	804.646.3055	alicia.zatcoff@richmondgov.com
Henrico County	Jerry Walker, Energy Manager	804.501.5763	wal03@co.henrico.va.us
Chesterfield County	Joe Lenzi, Energy Manager	804.748.1996	LenziJ@chesterfield.gov
Albemarle County	Sarah Temple		stemple@albemarle.org
James Madison University	Chris Bachman	540.568.2735	bachmacg@jmu.edu
University of Virginia	David Slutzky	434.989.5888	dslutzky@e2inc.com
Virginia Commonwealth University	Jacek Ghosh, Sustainability Manager	804.628.5199	jghosh@vcu.edu
J. Sargeant Reynolds Community College	Lawrence Schwendeman	804.523.5938	lschwendeman@reynolds.edu
Roanoke	Ken Bernard	540.853.2108	ken.bernard@roanokeva.gov

Utilities			
Dominion Electric Power	Sarah Cosby	804.819.2807	Sarah.cosby@dom.com
Old Dominion Electric Cooperative	David Hudgins	804.968.4068	dhudgins@odec.com
Civic Groups/Associations			
Virginia Clean Cities	Alleyn Harned	540.568.8896	aharned@hrccc.org
Electric Vehicle Association of Greater Washington DC	Russ Beyer	804.218.1440	russnmg@gmail.com
Advanced Energy	Jeff Barghout	919.857.9006	jbarghout@advancedenergy.org
Virginia Automobile Dealers Association	Mike Allen	804.545.3012	mallen@vada.com
Virginia Sierra Club	Charles Price	804.358.0256	fewmit@comcast.net
Virginia Municipal League	Joe Lerch	804.523.8530	jlerch@vml.org
Rocky Mountain Institute - PGR	Ben Holland	303.567.8579	bholland@rmi.org
Southern Environmental Law Center	Trip Pollard		tpollard@selcva.org
Businesses			
Advanced Vehicle Research Center	Dick Dell	919.870.9494	rddell@avrc.com
Evtran	Rebecca Hough	276.620.3196	rhough@evatran.com
Aker Wade	John Aker	434.975.6001	jennifer.linkous@akerwade.com
Coulomb	Scott Miller, Regional Sales	617.209.2278	smiller@coulombtech.com
Nissan	Tracy Woodard		
Ford	David Berdish		
Smith Electric Vehicles	Brett Gipe, Director, Eastern Sales	816.243.1656	brett.gipe@smithelectric.com
General Motors	Kristen Zimmerman		
Volkswagen	Douglas Skorupski		
ZAP	Rex Boyd	707.525.8658 x240	rboyd@zapworld.com
Werres	Rick Sanford	301.620.4000 x236	rsanford@werres.com
Encell	Fitz Woodrow	434.975.2355	fitz@encell.com
Segway of Richmond	Buck Ward	804.343.1850	bward@segwayofrichmond.biz
Nova Charge (charger dealer)	Helda Rodriguez	866.417.9995	heldarodriguez@novacharge.net
Urban Grid Solar	Erin Hensley	804.353.0491	erin@urbangridsolar.com
CarCharging.com	Trish Sayre	540.820.6894	TrishSayre@comcast.net

Appendix 9: Draft Recommendations from Stakeholder Group

This Appendix provides a draft listing of short-term, medium-term and long-term recommendations from the Virginia Get Ready Stakeholder Group. Short-term recommendations are items that the Virginia Get Ready stakeholders believe can be accomplished by December 2011, medium-term represents items that can be advanced by December 2013, and long-term items are those that will be accomplished after January 2014.

Short Term Recommendations

Electric Vehicle Tax Credit – Suggested Financial Incentive

The top incentive identified by the group is a $2,000 state tax credit for EV purchase to accompany a Federal Incentive. This credit can be justified as a short-term catalyst for electric vehicle adoption and a potential economic development draw. ***Virginia's General Assembly should consider and offer a state tax credit similar to other states, including a Maryland offering of a $2,000 EV purchase tax credit.*** Tennessee now offers a $2,500 tax credit for the first 1,000 purchasers. (5k California, 5k Georgia) Such a tax credit would assist in vehicle purchase and would enhance Virginia's competitive position in attracting electric vehicle manufacturers.

Transit Discount – Suggested Financial Incentive

Electric vehicles with limited range may be an excellent partnership in a locality with robust public transportation. As a marketing strategy, ***public transportation facilities should offer free or discounted public transportation passes for a pre-determined period with EV purchase*** (such as WMATA SmarTrip Card, GRTC Go-Card, or VRE and Amtrak). This could be accomplished through providing a fare card provider with copy of vehicle registration.

Guaranteed Free Battery Recycling for EV Owners – Suggested Non-Financial Incentive

Vehicle manufacturers or Virginia dealers could certify battery recycling for used batteries. The collection could be similar to the way Toyota dealers are encouraged and compensated for collecting batteries. This should be a simple task, as batteries often have extended (8-year) warranties and will likely still retain significant value even through end of life.

Rapid Permit Incentive

Virginia could consider a small local assistance grant to establish rapid permitting procedures. Some localities already have rapid permitting procedures and a small assistance incentive could allow more localities to follow suit or move to online services.

Rapid Deployment of Electric Vehicle Charging Infrastructure

The Virginia Project Get Ready stakeholders believe that both public utilities and non-utilities should be encouraged to offer electric vehicle charging services to electric vehicle users in the Commonwealth. Allowing as much participation in this sector as possible will help promote electric vehicle usage; the more electric vehicle charging locations that exist, the more consumers in Virginia will feel comfortable driving electric vehicles. ***The Virginia Project Get Ready stakeholders recommend that the Virginia General Assembly enact legislation to encourage rapid deployment of electric vehicle charging infrastructure throughout the Commonwealth.***

Public utilities may be a necessary catalyst for the electric vehicle marketplace and should help build out the Commonwealth's charging infrastructure. ***In keeping with the policy to provide broad access to charging services for the public, legislation should also specify that any chargers in the public domain should be available to all electric vehicle users.***

Utility Support for Electric Vehicle Charging Infrastructure

The electric vehicle sector is currently a "start up" industry. In the short term, there will be a relatively small number of electric vehicles on the road. However, electric vehicle charging services will need to be available at a penetration level high enough to address range anxiety and to provide reasonable access to charging services for electric vehicle users. In the early adoption phase of electric vehicles, we are presented with a "chicken or egg" challenge, because there will not be enough electric vehicles on the road to produce the requisite revenue to cover the costs of needed charging infrastructure. However, if the charging infrastructure is not deployed, consumers will be less inclined to purchase electric vehicles.

Investor-owned and other public utilities may be uniquely positioned to overcome such a challenge, if proper cost recovery mechanisms are put into place. In recognition of the "start up" nature of the electric vehicle industry, ***the Virginia General Assembly should enact legislation that encourages utilities to install and/or support the installation of public charging infrastructure in numbers proportionate to electric vehicle sales and in locations where vehicle sales have been highest. Utilities, acting in response to any legislation, should be entitled to recover in a timely manner the costs (subject to appropriate limits) of deployment of charging stations owned by the utility and electric infrastructure installed by the utility to support charging stations owned by third-parties.***

Special Discounted Electric Vehicle Charging Rates

Electric vehicle load in the mid to long term could increase peak electricity demand in Virginia and require upgrades to distribution facilities, therefore, ***it is important for the Commonwealth to promote mechanisms for mitigating the effect of electric vehicle charging load on peak demand. One easy and effective way to do so is through the availability of special electric vehicle off-peak charging rates that incentivize electric vehicle owners to charge at night when electric load is lowest and the cost of power is cheapest.*** Not only would this lower the overall cost of ownership for electric vehicle owners by giving them a cheaper way to charge their vehicles in the evening, it could also shift much of the vehicle charging into off-peak hours and avoid the potential peak demand impacts that could otherwise occur. Charging vehicles at night also promotes the value of intermittent wind energy which is most available at night. This opportunity could also help train EV owners to the most inexpensive charging habits.

Online communication of EV information

As a supplement to installation guides, many localities are beginning to host general EV information, including:

- Types of EVs available with timing assumptions
- Types of EVSE and how to decide which level is "best for you"
- Projected installation cost calculator based on a few key features of your home.

This information should be posted publically and be accessible through on a common Virginia site http://www.VirginiaEV.org.

Building Pre-planning

As new home and office parking facilities are considered, ***builders should consider electric vehicle parking as they upgrade the facility.*** This includes conduit for Level 1 and Level 2 EVSE, as well as charger installs when applicable. This could have ancillary benefits for the builder through the LEED certification credit for alternate fueling infrastructure.

Federal Incentives

Our federal representatives should continue to support creative federal incentives to drive this market.

Medium Term Recommendations

Emissions Inspection Discount

Electric vehicles such as the Nissan Leaf and Tesla Roadster will produce no tailpipe emissions, yet in areas with air attainment concerns they may still be required to get an emissions inspection. ***The State, and Northern Virginia localities that require emission inspections should provide a discount or exemption from environmental emissions***

inspections for electric vehicles that have no tail-pipe emissions. The small amount of money saved from emissions inspection costs can serve as an additional purchase incentive.

EZPass Discount - Suggested Financial Incentive

Reduced smart tag and EZPass toll charges for a fixed period for purchasers of EVs. ***VDOT, Smart Tag, and EZPass should review and consider a clean vehicle class and offer a small discount per toll.*** A compelling $.05 or 10% discount per toll for Clean Fuel vehicles could draw EV owners to Virginia's Smart Tag / EZ Pass. This effort will likely require an additional electric or clean fuel vehicle class for the national EZPass organization.

Regulation of Electric Sales

Regulatory changes should be made to allow private companies such as parking decks, hotels, and entrepreneurs to explicitly provide fee-based charging services, with electricity ultimately purchased from public utility or provided by on site renewable energy. California has recently advanced a similar process which could serve as a model for Virginia regulation. This is similar to Virginia entities re-selling natural gas. This process should have further review to address concerns with the perception of resale of electricity.

Electronic-permitting

Rapid online permitting processes are under development in a number of Virginia localities. ***As electronic permitting programs are successfully enacted and reviewed in 2010 and 2011, additional localities should follow the leadership of the "first-adopter" localities and institute simple online permitting processes to further accelerate charger deployment for vehicle purchasers***. An Oregon E-permitting process is expected to dramatically reduce the amount of time required for the permitting and inspection process. See Appendix 3 for more information and an example of an electronic permitting program. A centralized permitting process for charging station installation would be helpful as permitting is handled by municipality, as the process is handled through more than a hundred city and county offices. ***Localities should partner to share a collaborative online permit process if possible.***

Long-Term Recommendations

EV buyer installation guides on-line and in EV purchase centers

As referenced on the Rocky Mountain Institute Project Get Ready website, a number of localities across the nation are preparing for the wave of new EV owners by updating their websites to host a range of EV information. In particular, many localities are moving to supply installation guides for individual EV owners to inform them how the permitting and inspection process will work for their locality. These installation guides could also be distributed to local events and EV dealerships to distribute to potential EV buyers. A sample EVSE Installation Guide template is available in Appendix 4. ***Over time, all***

Virginia localities should post installation guides online or distribute literature to EV dealers. Additionally, a common Virginia site should attempt to gather and host this information.

Virginia building code requiring new construction to be pre-wired for EVs

A final strategy for dramatically reducing the process time for EVSE installation requires a requirement for new homes to be pre-wired for electric vehicles. British Columbia has recently put in place a requirement similar to this. ***The Virginia Board of Housing and Community Development should strongly consider a requirement for pre-wiring new homes for EVSE.*** This requirement drastically decreases the potential installation cost for a Level 2 residential EVSE. The adoption of a new home building code would require home builders to put in place wiring for EVSE at the time of any new construction. **Costs for this type of pre-installation are negligible**, and protects against the future substantial EVSE installation cost. ***In order to put this type of requirement in place, the Virginia Board of Housing and Community Development would have to approve an amendment to the Virginia Uniform Statewide Building Code. Once this is accomplished, localities should begin implementing its requirements.***