

# **Charged Up: Making Metropolitan Washington Electric Vehicle Ready**

Prepared by

Metropolitan Washington Council of Governments (COG)

for

Climate, Energy, and Environment Policy Committee (CEEPC)

&

COG Board of Directors

\*\*\*CEEPC REVIEW DRAFT\*\*\*

## ACKNOWLEDGEMENTS AND ROSTER

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*The participants in MWCOG’s regional electric vehicle readiness initiative who contributed to this report represent numerous and diverse stakeholder entities, which may be impacted in different ways by state-specific policies and regulatory rules. Given the disparate nature of policies and regulatory rules in the MWCOG region, no participant should be deemed to endorse or support all of the conclusions or recommendations contained in this report.*

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# CHARGED UP: MAKING THE WASHINGTON REGION ELECTRIC VEHICLE READY

## EXECUTIVE SUMMARY

This report seeks to provide a framework for establishing a regional readiness plan for the deployment of electric vehicles (EVs) in the metropolitan Washington region. While total EV ownership in the region is relatively low (compared with other cities such as Portland, Oregon, or Los Angeles), consumer interest in EVs is growing and more EV models are being introduced in the regional market. However, the metropolitan Washington region's charging infrastructure and EV policy frameworks are not yet positioned to accommodate greater market penetration of these vehicles. A coordinated approach will smooth the path to EV deployment and adoption by removing policy barriers and promoting infrastructure development while mitigating potential impacts on the electrical grid. This planning effort will help ensure that the region can receive the health, environmental, and sustainability benefits that this technology offers.

### BENEFITS OF EV DEPLOYMENT

EV adoption presents environmental, economic, and energy security benefits to the country and the region. The U.S. Department of Energy (DOE) sees the electrification of vehicles as one of the highest impact strategies for reducing greenhouse gas emissions between now and 2030. In particular, as a bridge to a low-carbon transportation system, electrification of gasoline-powered vehicles through approaches such as plug-in hybrid electric vehicles (PHEVs) is one way the United States could facilitate a transition to future fuel-cell electric vehicles (FCEVs), which are seen to have the lowest life cycle carbon emissions of the range of vehicles analyzed by DOE.

Since the electrical grid serving the metropolitan Washington region has a relatively low greenhouse gas emission profile, regionally EVs produce the equivalent greenhouse gas emissions of a 55–58 mpg conventional internal combustion vehicle.<sup>1</sup> In addition, the electricity grid may be able to more readily integrate renewable power than traditional transportation energy sources. The proportion of renewably produced power available on the grid will increase over the years as a result of the region's renewable portfolio standards and other renewable incentives and policies. EVs allow these emissions savings and environmental benefits to be transferred to the transportation sector.

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<sup>1</sup> Union of Concerned Scientists. *State of Charge: Electric Vehicles' Global Warming Emissions and Fuel-Cost Savings across the United States*. Rev. April 12, 2012. Available at [http://www.ucsusa.org/clean\\_vehicles/smart-transportation-solutions/advanced-vehicle-technologies/electric-cars/emissions-and-charging-costs-electric-cars.html](http://www.ucsusa.org/clean_vehicles/smart-transportation-solutions/advanced-vehicle-technologies/electric-cars/emissions-and-charging-costs-electric-cars.html)



As Corporate Average Fuel Economy (CAFE) standards increase, automobile original equipment manufacturers (OEMs) are investing more in EVs. In July 2011, President Obama announced that vehicle manufacturers would be required to meet a fleet-wide average fuel economy of 55 mpg by 2025. To meet a fleet-wide average fuel economy of 35.5 mpg in 2016, manufacturers are releasing more high-efficiency vehicles. Since 2009, the number of subcompact vehicles rated at least 30 mpg has tripled and large increases have also been seen in the midsize and crossover categories.<sup>2</sup> EVs, which offer ratings of 75 to over 100 miles per gallon equivalent (MPGe), will play an increasingly important role in auto manufacturers' fleets as they seek to meet the ambitious 2025 goal.<sup>3</sup>

EVs also offer economic benefits through fuel cost savings. They have very high energy efficiency ratings compared with conventional cars and can achieve as high as 94–112 MPGe. This energy efficiency gain translates directly to operational cost savings. Depending on fuel and electricity costs and miles driven, annual cost savings can be as high as \$900/year or more. On the basis of the U.S. average electricity price, EVs cost \$0.02 to \$0.04 per mile to operate,<sup>4</sup> compared with \$0.10 to \$0.15 per mile for conventional cars (see [http://www.afdc.energy.gov/afdc/vehicles/electric\\_benefits.html](http://www.afdc.energy.gov/afdc/vehicles/electric_benefits.html)). Table ES-1 shows the EV efficiency ratings of four EV models.

**Table ES-1**  
**Electric Vehicle Efficiency Ratings**

2012 Models	Mitsubishi "i"	Ford Focus EV	Nissan LEAF	Chevy Volt
<b>Electric efficiency (kWh/mile)</b>	0.3	0.32	0.34	0.36
<b>Energy efficiency rating (MPGe)</b>	112	105	99	94

Source: U.S. Department of Energy, [www.fueleconomy.gov](http://www.fueleconomy.gov)

<sup>2</sup> Natural Resources Defense Council. *Relieving Pain at the Pump*. May 2, 2012. Available at

<http://www.nrdc.org/energy/relievingpainatthepump.asp>

<sup>3</sup> U.S. Department of Energy. *2011–12 Electric Vehicles*. Available at <http://www.fueleconomy.gov/feg/evsbs.shtml>

<sup>4</sup> In the metropolitan Washington region, EVs are estimated to cost approximately \$0.04 to \$0.06 per mile (based on the Pepco standard offer rate). Union of Concerned Scientists, *State of Charge: Electric Vehicles' Global Warming Emissions and Fuel-Cost Savings across the United States*. Rev. April 12, 2012. Available at [http://www.ucsusa.org/clean\\_vehicles/smart-transportation-solutions/advanced-vehicle-technologies/electric-cars/emissions-and-charging-costs-electric-cars.html](http://www.ucsusa.org/clean_vehicles/smart-transportation-solutions/advanced-vehicle-technologies/electric-cars/emissions-and-charging-costs-electric-cars.html)

While studies have shown that it can take seven years or more for the operational savings to offset the incrementally higher up-front cost to buy an EV (even when gas prices are in the \$4–\$5 range), EV buyers are also motivated by factors other than the time it takes to pay off the initial investment in a cleaner vehicle. EVs offer their owners protection against future gasoline price volatility. In Houston, for example, members of the NRG network enjoy a low fixed monthly fee for unlimited charging at home and at any of the network charging locations in the metropolitan area. And because EVs rely on domestically produced electricity rather than on petroleum, a largely imported fuel, they promote energy security.

Reducing vehicle emissions is critical to achieving the region’s air quality goals, and EVs can play an important role in realizing these reductions. In the metropolitan Washington region, transportation emissions accounted for 55 percent of NOx emissions and 16 percent of fine particle (PM<sub>2.5</sub>) emissions in 2007. EVs’ zero or low emission status makes them good candidates to contribute significantly to the regional efforts to reduce pollution from mobile sources.

Despite the benefits of EVs, challenges such as unfamiliarity with the technology, range anxiety, underdeveloped charging networks, and the limited availability and relatively high cost of vehicles have hindered their adoption. In addition, the absence of a clear and robust policy framework for EV planning and infrastructure—which considers permitting, siting, zoning, utility policy, and other issues—has amplified existing market barriers. A regional strategy is needed to bridge these obstacles and clear the way for wider EV recognition and use.

#### **RECENT COG EV PLANNING INITIATIVES**

COG held an EV Workshop in early 2011 to examine successful local and regional EV readiness strategies and to begin the conversation at a regional level on how to effectively and collectively deploy EV transportation technology. Participants, including local governments and industry experts, agreed on the need for an EV readiness strategy to facilitate deployment of EVs in the metropolitan Washington region.

To understand the current landscape of the metropolitan Washington region, COG conducted a survey of its 22 member jurisdictions in early 2012 about their EV permitting and infrastructure planning. Results of the survey indicated that with some exceptions, most local jurisdictions in the region were not aware of or looking at EVs as a potential issue.

COG’s Transportation Planning Board (TPB) conducted a scenario study examining the role of regional transportation in climate change mitigation in the metropolitan Washington region called *What Would It Take? Transportation and Climate Change in the National Capital*

*Region.*<sup>5</sup> The study tries to answer the question of what it would take to meet aggressive greenhouse gas emission reduction goals in transportation in the metropolitan Washington region. Although EVs were not specifically mentioned in the study, it concluded that national-level CAFE standards and alternative fuel mandates are needed to reduce emissions and contribute to the environmental resilience of the region.

In 2011, to respond to the interest in EV planning in the metropolitan Washington region, COG and the Greater Washington Region Clean Cities Coalition embarked on a new regional Electric Vehicle Planning Initiative. The Electric Vehicle Planning Initiative is heavily stakeholder-driven. The scope of the strategy development is to identify the issues for regional EV deployment and to make recommendations for the region and local jurisdictions to consider in designing and implementing programs to facilitate adoption of EVs.

The primary Electric Vehicle Planning Workgroups (referred to herein as the Task Force) were focused on infrastructure development and local government policy. The Task Force considered information on vehicle ownership and usage patterns, as well as best practices locally and from around the United States, to assist in developing considerations, recommendations, and priorities for an EV strategy for the metropolitan Washington region. Subgroups were formed to address infrastructure siting, comprehensive planning, zoning, building codes, permitting/inspection, electric utility policy, EV use in fleets, and outreach and education. This report addresses each of these topics.

## **EV and EVSE DEPLOYMENT PLANNING**

### **Regional Forecast for EV Ownership**

Currently, there are approximately 500 EVs registered in the metropolitan Washington region. At least three major EV and PHEV models are available in the region, and service to convert hybrids to PHEVs is available. Nationwide, there were approximately 57,000 EVs in operation as of 2009,<sup>6</sup> and DOE projects that there could be 1.2 million EVs on the road by 2015.<sup>7</sup>

While there is no way to know exactly how many EVs will be operating in the region in coming years, one approach to predicting future regional EV demand is to analyze the experience of hybrid vehicles and the early adopters. COG staff analyzed registration data available from TPB from 2005 to 2011. In just six years, the number of registered hybrid vehicles grew by more than

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<sup>5</sup> COG Transportation Planning Board. *What Would It Take? Transportation and Climate Change in the National Capital Region*. May 18, 2010. Available at <http://www.mwccog.org/uploads/committee-documents/kV5YX1pe20100617100959.pdf>

<sup>6</sup> U.S. Energy Information Administration. *Frequently Asked Questions*. Available at <http://www.eia.gov/tools/faqs/faq.cfm?id=93&t=4>

<sup>7</sup> U.S. Department of Energy. *One Million Electric Vehicles by 2015*. February 2011. Available at [http://www1.eere.energy.gov/vehiclesandfuels/pdfs/1\\_million\\_electric\\_vehicles\\_rpt.pdf](http://www1.eere.energy.gov/vehiclesandfuels/pdfs/1_million_electric_vehicles_rpt.pdf)

600 percent, from approximately 12,000 vehicles to more than 70,000. However, total registered hybrid vehicles in the region still represent approximately 1.5 percent of all vehicle registrations. Using the most conservative estimate of regional EV adoption by 2015–2020, if EVs experience a 600% increase in five years—mirroring the rate of adoption of hybrids—the region could have 1,500 to 3,000 EVs operating on the roadways (up from the current number of approximately 500 vehicles). As a high estimate, if total EV sales in the next eight to 10 years reach fleet levels comparable to current levels of hybrids, the region could see anywhere from 50,000 to 75,000 EVs operating on the roadways by 2020.

### **Potential for EV Use**

According to COG’s Household Travel Survey, most vehicle trips in the region are relatively short, with an average vehicle trip length of 7.7 miles. This is well within the range of one charge for most vehicles. Therefore, for most daily commutes and other trip purposes, the relatively short length of the trips would not cause significant range anxiety.

**Trips to Work.** Most automobile commuting trips in the region, 55 percent, end in one of the metropolitan area's Regional Activity Centers (see sidebar). A high proportion of these commuting trips—91 percent—are shorter than 20 miles one way. A small proportion of auto commute trips—1.3 percent—are longer than 40 miles. This suggests that EVs could serve the needs of most daily work commuters headed to Regional Activity Centers.

**Trips for Shopping.** Shopping trips also involve a significant number of automobile trips that are shorter than 20 miles—96 percent. EVs could be accommodated by home charging or car-share charging, with some retail charging locations helpful as a backup or for drivers who conduct more than one trip on a charge.

**Trip Length and Electric Vehicle Range.** Electric-only and hybrid-electric models available in the region that could reasonably rely on electric fuel alone are designed to travel from 56 to 72 miles on one charge. A fairly conservative rule of thumb for EV range is 20 miles one way, although some models handle a much longer journey depending on driving conditions.

### **Evse Site Locations**

A growing EV charging infrastructure exists in the metropolitan Washington region as a result of stimulus funding through state governments and private investment. The companies and EV initiatives using federal stimulus funds to site public and residential EV infrastructure in parts of the metropolitan Washington region include ECotality’s The EV Project, Coulomb’s ChargePoint America Program, the Maryland Electric Vehicle Infrastructure Program (EVIP)/BEVI (Baltimore–Washington Electric Vehicle Initiative), and the Northeast Regional Electric Vehicle Network project.

For plug-in electrical vehicle (PEV) owners, most charging will likely occur at home, with workplace charging a close second.

Multifamily and urban dwellers without a dedicated garage or driveway will require innovative charging solutions.

### **PUBLICLY ACCESSIBLE EV CHARGING STATIONS**

COG staff developed an inventory of EV charging stations for the metropolitan Washington region. A robust network of charging stations is beginning to take shape in the region. Altogether, the inventory identified 332 chargers in 133 charging station locations, 11 of which are planned stations. The District of Columbia has the most charging stations among COG jurisdictions (36), followed by Arlington County, Virginia (15); Fairfax County, Virginia (18); and Charles County, Maryland (11). The

District of Columbia and Arlington County, Virginia, have the highest number of chargers (85 and 62, respectively). About 40 percent of the chargers are Level 1, and the remaining 60 percent are Level 2. No DC fast chargers were installed when the inventory was developed. The inventory indicates that building managers are installing EVSE in a variety of land uses.

### **LOCAL GOVERNMENT POLICY**

Local governments will play a critical role in the region's EV readiness. To facilitate continued growth of the market and smooth the transition to higher rates of EV adoption, local governments must ensure that EV infrastructure development is addressed in comprehensive planning efforts and that zoning, building codes, and permitting and inspection processes provide a pathway to the expeditious installation of charging equipment. Streamlined permitting and inspection processes, EV and charging incentives, infrastructure readiness, low permitting and inspection costs, and nominal installation costs all contribute to a more EV-friendly policy environment.

The January 2012 COG survey of EV initiatives in the region provided an overview of the current status of local government EV initiatives. Most COG jurisdictions reported having no EV

As part of their *Park and Charge* Pilot Program, the District of Columbia installed the first public curbside electric vehicle charging station in the United States at the intersection of 14<sup>th</sup> & U St., NW, in 2010 in partnership with ChargePoint America and Pepco and partially supported by federal grants. Between installation and April 2012, the station was utilized for 135 charging sessions. The District plans to open at least two more stations at the Washington Canal Park in May 2012.



Source: The District of Columbia Department of Transportation. *Park and Charge Pilot*. Available at <http://ddot.dc.gov/DC/DDOT/Services/Parking+Services/View+All/Park+and+Charge+Pilot>

policy development in place. Two exceptions in the area of zoning were the integration by the District of Columbia and Fairfax County, Virginia, of EV zoning considerations into the permit review process, building code policy, and ADA parking restrictions.

Reducing the cost of obtaining electrical permits, in terms of both time and money, can facilitate the installation of EV charging stations. The District of Columbia and Fairfax, Virginia, reported the fastest turnaround times for obtaining electrical permits. Falls Church, Virginia, reported the least expensive permitting costs for all types of electrical permits, and most reporting jurisdictions indicated that they offer online permit applications. The tracking of EV charging permit applications yields important data on planned EVSE infrastructure. Of responding jurisdictions, only the City of Frederick, Maryland, and the City of Falls Church, Virginia, indicated that they are tracking EV charging permit applications.

### **ELECTRIC UTILITY POLICY**

The regulatory status of EV charging stations—contained in provisions of electric utility policy—can help or hinder the ability of private companies and utilities to provide EV charging services. Across the region, the regulatory status of EV charging service providers is inconsistent and in some cases unclear. Clear state-level policies are needed to promote private investment in EV charging infrastructure for charging in the for-pay charging market. Ideally, local and state policy would allow utilities to be notified in advance about the location of EV charging equipment so they can ensure that appropriate infrastructure is in place to accommodate the increased load and avoid service disruptions for their customers.

Maryland, Virginia, and the District of Columbia have all taken steps in recent years to resolve areas of uncertainty in their electric utility policy as it relates to EVs and EV charging. However, room for improvement remains, particularly when it comes to notifying utilities about EV charging station locations.

### **BENEFITS OF EV FOR FLEET USE**

A 2012 survey of fleets in the metropolitan Washington region found that EVs are being adopted slowly. The Greater Washington Region Clean Cities Coalition's<sup>8</sup> survey of 11 fleet managers found that most EVs currently in operation are used onsite, such as trucks used on landfills or campus landscaping equipment. According to the Coalition, fleet managers cite the cost of EVs and infrastructure as obstacles to purchasing additional EVs.

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<sup>8</sup> Greater Washington Region Clean Cities Coalition. *Clean Cities 2011 Annual Report*. Spring 2012.

## **OUTREACH AND EDUCATION**

The current information gap for the public's knowledge of electric and conventional vehicles is substantial. Education efforts by private and public entities (including nongovernmental organizations, electric utilities, PEV service providers, auto dealers, other businesses, and government) are needed to bridge the gap.<sup>9</sup> To set the stage for EV marketplace success in the metropolitan Washington region, regional partners involved in the Metropolitan COG Electric Vehicle Planning Initiative have identified key target audiences and information needs for those audiences.

## **SUMMARY OF RECOMMENDATIONS**

Achieving EV readiness in the metropolitan Washington region will require a coordinated approach among local governments, utilities, players in the EV industry, and nonprofit groups. This report contains recommendations for these stakeholders to promote a consistent set of practices across the region that will remove barriers to EV adoption and infrastructure planning.

The top five recommendations to facilitate EV deployment in the region are as follows:

1. Stakeholder partnerships should be formed to align incentives toward maximizing the rollout of EVs and EVSE, to present the business case for EVs, and to make the community return on investment clear.
2. Local and state officials, employers, property managers, and other EV stakeholders should consider offering incentives to spur early stages of the EV market, including preferred parking and HOV occupancy exceptions for EV drivers and benefits for developers who invest in EVSE infrastructure.
3. Electric permitting procedures should identify EVSE installations and notify electric utilities of their locations.
4. Outreach and education is needed to promote EV adoption and inform the public of its benefits.
5. Comprehensive plans and zoning regulations should guide EV infrastructure development and ensure that the built environment can accommodate future EVSE installations.

Further details are provided in the report and appendices.

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<sup>9</sup> Center for Climate and Energy Solutions. *An Action Plan to Integrate Plug-in Electric Vehicles with the U.S. Electrical Grid*. March 2012. Available at <http://www.c2es.org/docUploads/PEV-action-plan.pdf>

## SECTION 1

### INTRODUCTION

#### GOALS

This report seeks to provide a framework for establishing a regional readiness plan for the deployment of electric vehicles (EVs) in the metropolitan Washington region. While total EV ownership in the region is relatively low (compared with other cities such as Portland, Oregon, or Los Angeles), consumer interest in EVs is growing. However, the metropolitan Washington region's charging infrastructure and EV policy frameworks are not yet positioned to accommodate greater market penetration of these vehicles. A coordinated approach will smooth the path to EV deployment and adoption by removing policy barriers and promoting infrastructure development while mitigating potential impacts on the electrical grid. This planning effort will help ensure that the region can receive the health, environmental, and sustainability benefits that this technology offers.

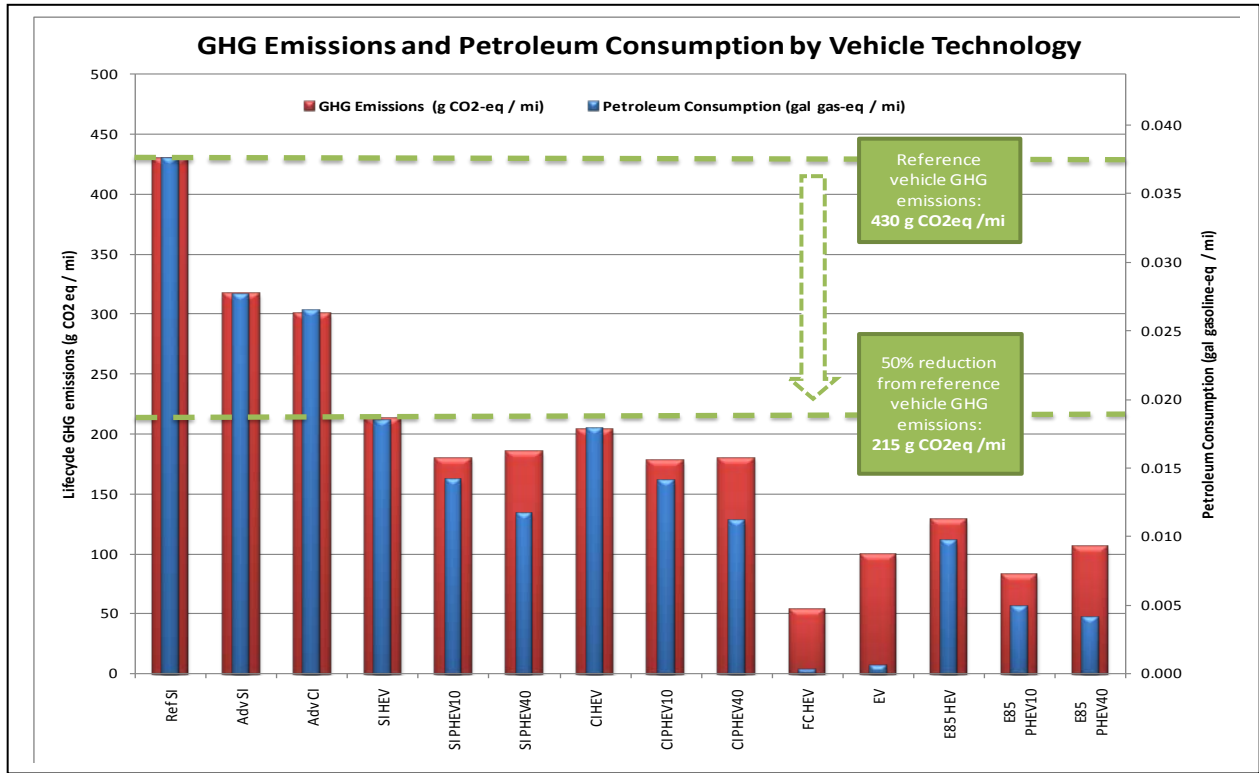
#### BENEFITS OF EV DEPLOYMENT

EV adoption presents environmental, economic, and energy security benefits to the country and the region. The U.S. Department of Energy (DOE) sees the electrification of vehicles as one of the highest impact strategies for reducing greenhouse gas emissions between now and 2030. In particular, as a bridge to a low-carbon transportation system, electrification of gasoline-powered vehicles through approaches such as plug-in hybrid electric vehicles (PHEVs) is one way the United States could facilitate a transition to future fuel-cell electric vehicles (FCEVs), which are seen to have the lowest life cycle carbon emissions of the range of vehicles analyzed by DOE. Figure 1-1 shows the greenhouse gas emissions and petroleum consumption of alternative vehicle technologies.

Battery-only EVs (or BEVs) are often referred to as *zero emissions* vehicles because unlike internal combustion vehicles, they emit no tailpipe emissions such as ground-level ozone, fine particulate matter, nitrous oxides, volatile organic compounds, carbon monoxide, and carbon dioxide. Although the generation of electricity necessary to charge EVs may produce emissions depending on the generation source, emissions associated with EV charging are significantly lower than those produced by internal combustion engine vehicles. Furthermore, EVs do not produce the unhealthy local concentrations along roadways that conventional vehicles do.



**Figure 1-1  
Greenhouse Gas Emissions and Petroleum Consumption by Vehicle Technology**



Source: [http://www1.eere.energy.gov/vehiclesandfuels/pdfs/program/vt\\_mypp\\_2011-2015.pdf](http://www1.eere.energy.gov/vehiclesandfuels/pdfs/program/vt_mypp_2011-2015.pdf)

**Legend:**

- Ref. S—reference spark-ignition gasoline engine vehicle
- Adv. SI—advanced spark ignition gasoline engine vehicle
- Adv. CI—advanced compression-ignition diesel engine vehicle
- SI HEV—spark-ignition gasoline engine/hybrid electric vehicle
- SI PHEV10—spark-ignition gasoline engine/plug-in hybrid electric vehicle (10-mile all-electric range)
- SI PHEV40—spark-ignition gasoline engine/plug-in hybrid electric vehicle (40-mile all-electric range)
- CI HEV—compression-ignition diesel engine/hybrid electric vehicle
- CI PHEV10—compression-ignition diesel engine/plug-in hybrid electric vehicle (10-mile all-electric range)
- CI PHEV40—compression-ignition diesel engine/plug-in hybrid electric vehicle (40-mile all-electric range)
- FC HEV—fuel cell/hybrid electric vehicle
- EV—electric vehicle
- E85 HEV—85% biomass-gasoline blend/hybrid electric vehicle
- E85 PHEV10—85% biomass-gasoline blend/plug-in hybrid electric vehicle (10-mile all-electric range)
- E85 PHEV40—85% biomass-gasoline blend/plug-in hybrid electric vehicle (40-mile all-electric range)

EVs also offer economic benefits through fuel cost savings. They have very high energy efficiency ratings compared with conventional cars and can achieve as high as 94–112 miles per gallon equivalent (MPGe). This efficiency translates directly to operational cost savings. Depending on fuel costs, electricity costs, and miles driven, annual cost savings can be as high as \$900/year or more. Based on U.S. average electricity price, EVs cost \$0.02 to \$0.04 per mile to

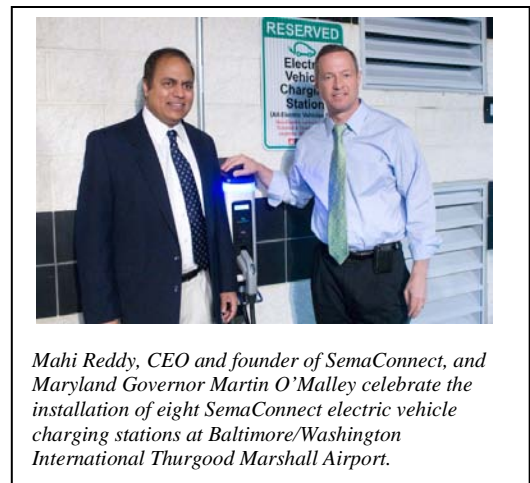
operate,<sup>10</sup> compared with \$0.10 to \$0.15 per mile for conventional cars (see [http://www.afdc.energy.gov/afdc/vehicles/electric\\_benefits.html](http://www.afdc.energy.gov/afdc/vehicles/electric_benefits.html)). Table 1-1 shows the EV efficiency ratings of four EV models.

**Table 1-1**  
**Electric Vehicle Efficiency Ratings**

2012 Models	Mitsubishi “i”	Ford Focus EV	Nissan LEAF	Chevy Volt
<b>Electric efficiency (kWh/mile)</b>	0.3	0.32	0.34	0.36
<b>Energy efficiency rating (MPGe)</b>	112	105	99	94

Source: U.S. Department of Energy, [www.fueleconomy.gov](http://www.fueleconomy.gov)

While studies have shown that it can take seven years or more for the operational savings to offset the incrementally higher up-front cost to buy an EV (even when gas prices are in the \$4–\$5 range), EV buyers are also motivated by factors other than the time it takes to pay off the initial investment in a cleaner vehicle. EVs offer their owners protection against future gasoline price volatility. In Houston, for example, members of the NRG network enjoy a low fixed monthly fee for unlimited charging at home and at any of the network locations in the metropolitan area. And because EVs rely on domestically produced electricity rather than on petroleum, a largely imported fuel, they promote energy security.



<sup>10</sup> In the metropolitan Washington region, EVs are estimated to cost approximately \$0.04 to \$0.06 per mile (based on the Pepco standard offer rate). Union of Concerned Scientists, *State of Charge: Electric Vehicles' Global Warming Emissions and Fuel-Cost Savings across the United States*. Rev. April 12, 2012. Available at [http://www.ucsusa.org/clean\\_vehicles/smart-transportation-solutions/advanced-vehicle-technologies/electric-cars/emissions-and-charging-costs-electric-cars.html](http://www.ucsusa.org/clean_vehicles/smart-transportation-solutions/advanced-vehicle-technologies/electric-cars/emissions-and-charging-costs-electric-cars.html)

## **NEED FOR READINESS PLANNING**

Despite the benefits of EVs, challenges such as unfamiliarity with the technology, range anxiety, underdeveloped charging networks, and the limited availability and relatively high cost of vehicles have hindered their adoption. In addition, the absence of a clear and robust policy framework for EV planning and infrastructure—which considers permitting, siting, zoning, utility policy, and other issues—has amplified existing market barriers. A regional strategy is needed to bridge these obstacles and clear the way for wider EV recognition and use.

## **PROMOTING REGIONAL GOALS**

The benefits offered by EVs make them uniquely positioned to contribute to regional goals of sustainability, climate change mitigation, and air quality improvement.

### **Regional Vision for Sustainability**

COG's *Region Forward* initiative calls for “a significant decrease in greenhouse gas emissions, with substantial reductions from the built environment and transportation sector,” as well as “protection and enhancement of the region’s environmental resources by meeting and exceeding standards for our air, water, and land.”<sup>11</sup> Specifically, it sets the goals of reducing regional greenhouse gas emissions by 20 percent below 2005 levels by 2020 and by 80 percent below 2005 levels by 2050. It also calls for the region’s air quality to improve by 2014 through a reduction in ambient pollutant concentrations to below federal maximums. (See Appendix A for a more extensive description of COG’s mission and activities.)

### **Greenhouse Gas Reductions**

The *National Capital Region Climate Change Report* and the action plan of the Climate Energy and Environment Policy Committee establish specific milestones to be achieved to meet the region’s ambitious climate change goals. Relevant to EVs, the plan calls for increased fuel efficiency and accelerating the adoption of efficient clean-fuel vehicles.

According to the Union of Concerned Scientists, based on EPA data, “the average EPA window-sticker fuel economy rating of all compact vehicles sold in 2010 (the most recent year for which data are available) was 27 mpg, while midsize vehicles averaged about 26 mpg. This means that even when charging an EV with electricity made only from coal, the dirtiest electricity source, the EV has better emissions than the average new compact gasoline vehicle.”<sup>12</sup> The Union of

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<sup>11</sup> Metropolitan Council of Governments. *Region Forward: Sustainability Targets*. Available at <http://www.regionforward.org/sustainability-targets>

<sup>12</sup> Union of Concerned Scientists. *State of Charge: Electric Vehicles’ Global Warming Emissions and Fuel-Cost Savings across the United States*. April 2012 prepublication version. Available at [http://www.ucsusa.org/assets/documents/clean\\_vehicles/electric-car-global-warming-emissions-report.pdf](http://www.ucsusa.org/assets/documents/clean_vehicles/electric-car-global-warming-emissions-report.pdf)

Concerned Scientists’ data on the MPGe generated by alternative electricity sources are presented in Table 1-2.

**Table 1-2**  
**Well-to-Wheels EV Global Warming Emissions (mpg<sub>ghg</sub>) by Electricity Generation Source**

Electricity Source	EV Global Warming Emissions in Gasoline Miles per Gallon Equivalent (mpg <sub>ghg</sub> )
Coal	30
Oil	32
Natural Gas	54
Solar	500
Nuclear	2,000
Wind	3,900
Hydro	5,800
Geothermal	7,600

Source: Union of Concerned Scientists, [http://www.ucsusa.org/assets/documents/clean\\_vehicles/electric-car-global-warming-emissions-report.pdf](http://www.ucsusa.org/assets/documents/clean_vehicles/electric-car-global-warming-emissions-report.pdf)

Since the electrical grid serving the metropolitan Washington region has a relatively low greenhouse gas emission profile, regionally EVs produce the equivalent greenhouse gas emissions of a 55–58 mpg conventional internal combustion vehicle.<sup>13</sup> In addition, the electricity grid may be able to more readily integrate renewable power sources than traditional transportation energy sources. The proportion of renewably produced power available on the grid will increase over the years as a result of the region’s renewable portfolio standards and other renewable incentives and policies. EVs allow these emissions savings and environmental benefits to be transferred to the transportation sector.

### **Air Quality and Transportation Planning**

Reducing vehicle emissions is critical to achieving the region’s air quality goals, and EVs can play an important role in realizing these reductions. In the metropolitan Washington region, transportation emissions accounted for 55 percent of NOx emissions and 16 percent of fine particle (PM<sub>2.5</sub>) emissions in 2007.

<sup>13</sup> Union of Concerned Scientists. *State of Charge: Electric Vehicles’ Global Warming Emissions and Fuel-Cost Savings across the United States*. Rev. April 12, 2012. Available at [http://www.ucsusa.org/clean\\_vehicles/smart-transportation-solutions/advanced-vehicle-technologies/electric-cars/emissions-and-charging-costs-electric-cars.html](http://www.ucsusa.org/clean_vehicles/smart-transportation-solutions/advanced-vehicle-technologies/electric-cars/emissions-and-charging-costs-electric-cars.html)

EVs' zero or low emission status makes them good candidates to contribute significantly to the regional efforts to reduce pollution from mobile sources. As mentioned earlier, electric generation sources in the region have recently either switched fuels or installed controls to dramatically reduce emissions and are for the most part located far away from highly populated areas. This means that reliance on the electric grid to provide clean reliable low-cost power for the transportation sector can contribute significantly to improving air quality.

COG's Transportation Planning Board (TPB) conducted a scenario study examining the role of regional transportation in climate change mitigation in the metropolitan Washington region called *What Would It Take? Transportation and Climate Change in the National Capital Region*.<sup>14</sup> The study tries to answer the question of what it would take in the metropolitan Washington region to meet aggressive greenhouse gas emission reduction goals in transportation. Although EVs were not specifically mentioned in the study, it concluded that national-level Corporate Average Fuel Economy (CAFE) standards and alternative fuel mandates are needed to reduce emissions and contribute to the environmental resilience of the region.

## **BARRIERS AND CHALLENGES**

The perception that EVs are less convenient than conventional internal combustion or gasoline hybrid vehicles is a significant obstacle to EV adoption. Concerns about running out of charge and not having access to a charging station can deter potential EV buyers. Related to this issue is the public perception that there is a lack of publicly available EV charging infrastructure. Increasing the number and visibility of public charging stations could reduce range anxiety and increase EV acceptance. Developing solutions for potential EV owners who reside in multifamily buildings and do not have access to a reliable electrical outlet for EV charging would also promote EV acceptance.

The current low market demand for EVs dampens interest in both the public and private sectors in investing in EV charging networks. While adequate charging infrastructure is a prerequisite to more widespread EV adoption, the fact that charging demand does not currently exist is a barrier to its construction.

There is also disagreement about the appropriate role for the private sector and local governments in incentivizing or promoting EV infrastructure build-out. Some stakeholders see government involvement as an endorsement of private sector products. Others see the government as having a critical role to play in EV infrastructure development, given its public

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<sup>14</sup> COG Transportation Planning Board. *What Would It Take? Transportation and Climate Change in the National Capital Region*. May 18, 2010. Available at <http://www.mwccog.org/uploads/committee-documents/kV5YX1pe20100617100959.pdf>

benefits. In fact, DOE's investments in EV infrastructure between 2009 and 2011 have been a significant factor in the deployment of EVs in California, Oregon, and Washington state.

### **EV STIMULUS PROGRAMS IN THE REGION**

In 2009, DOE's National Clean Cities Program provided \$300 million in American Recovery and Reinvestment Act (ARRA) stimulus funds for projects aimed at accelerating the deployment of alternative-fuel vehicles and building the infrastructure needed to support them. Twenty-five grants were awarded in 2010 ranging from \$5 million to \$15 million, each with a 50 percent matching requirement. The funding was designated to accelerate the adoption of hybrids, EVs, and plug-in electric hybrids, as well as natural gas and biofuel-powered vehicles. Projects that were awarded in the metropolitan Washington region include ECOtality's The EV Project (2009), Coulomb Technologies' ChargePoint America Program (2010), the New York State Energy Research and Development Authority's Northeast Regional Electric Vehicle Network project (2011), and the Maryland Energy Administration's Maryland Electric Vehicle Infrastructure Project (2010).

DOE is actively promoting EVs through grants to Clean Cities Coalitions, local governments, and EV infrastructure companies. Although not a primary beneficiary of DOE EV grants, the metropolitan Washington region may benefit from grants supporting the development of regional strategic plans to facilitate the adoption of EVs and the associated infrastructure in the nearby cities of Baltimore and Richmond.

### **RECENT COG EV PLANNING INITIATIVES**

#### **Regional Readiness**

COG held an EV Workshop in early 2011 to examine successful local and regional EV readiness strategies and to begin the conversation on a regional level on how to effectively and collectively deploy EV transportation technology. Participants, including local governments and industry experts, agreed on the need for an EV readiness strategy to facilitate deployment of EVs in the metropolitan Washington region.

COG surveyed 22 member jurisdictions in early 2012 regarding their EV permitting and infrastructure planning. Results of the survey indicated that most local jurisdictions in the region were not aware of or looking at EVs as a potential issue.

#### **Planning Strategy Development**

In 2011, to respond to the interest in EV planning in the metropolitan Washington region, COG and the Greater Washington Region Clean Cities Coalition embarked on a new regional EV Planning Initiative. The EV Planning Initiative is heavily stakeholder-driven. The scope of the strategy development is to identify the issues for regional EV deployment and to make

recommendations for the region and local jurisdictions to consider in designing and implementing programs to facilitate adoption of EVs.

The primary Electric Vehicle Planning Workgroups (referred to herein as the Task Force) were focused on infrastructure development and municipal policy. Subgroups were formed to address comprehensive planning, zoning, building codes, permitting/inspection, infrastructure siting, electric utility policy, fleets, and outreach and education.

The list of Task Force members contributing to the process included vehicle owners, state and local government staff (transportation and energy planners), EV original equipment manufacturers (OEMs), EVSE suppliers, nonprofit agencies (e.g., the Georgetown Climate Center, the Electric Drive Transportation Association, the Electric Vehicle Association of Greater Washington DC), and electric utility representatives from the three states. The Task Force provided direction, feedback, and data sharing on EV deployment issues.

COG staff assessed the status of EVs in the region and recommended steps to improve and enhance regional readiness for EVs. The main areas of concern were EV and EVSE infrastructure (existing and planned), as well as the range of policies that may have an impact on EV or EVSE deployment and/or public acceptance of EVs.

The following are some suggested government roles that could be considered:

- Reducing barriers to and streamlining permitting;
- Standardizing design and safety requirements;
- Disseminating information on best practices, regulations, federal tax credits, and technical assistance;
- Implementing incentives to support initial ramp-up momentum (e.g., tax breaks, EV car-sharing incentives);
- Developing requirements and guidelines for infrastructure implementation, including where and how; and
- Partnering with utilities and EV service companies around grid issues, revenue requirements, and creation of a subscription network.

The Task Force considered information on vehicle ownership and usage patterns, as well as best practices from around the United States to assist in developing considerations, recommendations, and priorities for an EV strategy for the metropolitan Washington region.

This report sets the stage with an overview of the state of EV and EVSE technology and the extent of current and projected availability in the metropolitan Washington region of particular EV models and types of charging equipment. (Appendix B contains a glossary of terms introduced in the report, and Appendix C provides a list of related resources and links.) The next section discusses current EV ownership and charging stations in the region, with implications for infrastructure planning. Comprehensive planning, zoning, building codes, and permitting and inspections are key to preparing for and promoting EV readiness in the region—the section on Local Government Policy summarizes current practices in the region and best practices from EV programs nationwide. Electric utility policy is also key to EV readiness in the region. That section discusses the potential for impacts of EV use on the electrical grid as well as key regulatory issues and concerns. The next section explores the advantages of EVs for fleet use and the current and anticipated use of EVs in both public and private fleets. The section on Outreach and Education defines the target audiences related to EV adoption and discusses current training resources and unmet EV information needs, including those related to public safety, payment mechanisms, available incentives, and emissions and congestion benefits. Finally, a summary of recommendations designed to promote EV readiness in the region is presented.



## SECTION 2

# EV AND EVSE MODELS, MANUFACTURERS, AND NETWORK DEVELOPERS

This section presents some background on electric vehicle (EV) and electric vehicle supply equipment (EVSE) technologies and on current product and service offerings. First, different technologies used in EVs are discussed, followed by descriptions and photos of EV models that are currently available. Then, some background on vehicle charging technologies is presented, followed by a listing of manufacturers who are heavily invested in this market. Market participants include charging station manufacturers, those who work with EVSE suppliers to set up and manage charging networks, and those who develop and distribute related software products.

### BACKGROUND ON EV TECHNOLOGIES

The major types of EVs are discussed below, along with their powering mechanism and battery range.

**All-Electric Vehicles.** All-electric vehicles (EVs), sometimes referred to as *battery electric vehicles* (BEVs) or *plug-in electric vehicles* (PEVs), use a battery to store electricity that powers the motor. Most EVs available now have a minimum range of 100 miles per charge, which is sufficient to cover over 90 percent of household vehicle trips according to the U.S. Department of Transportation.<sup>15 16</sup>

**Plug-In Hybrid Electric Vehicles.** Plug-in hybrid electric vehicles (PHEVs) contain both an internal combustion engine and an electric motor and battery. The battery can be charged by plugging in, by the combustion engine, or through regenerative braking. These vehicles offer 10 to 40 miles of battery range. If not charged by plugging in, they achieve roughly the same fuel economy as similarly sized conventional hybrid vehicles.<sup>17</sup>

**Hybrid Electric Vehicles.** Hybrid electric vehicles (HEVs) contain an internal combustion engine that runs on conventional liquid fuels but is supplemented by an electric motor and on-board battery. The combustion engine and regenerative braking are used to charge the battery in

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<sup>15</sup> U.S. Department of Energy, Alternative Fuels & Advanced Vehicles Data Center. *All-Electric Vehicles*. Available at [http://www.afdc.energy.gov/afdc/vehicles/electric\\_basics\\_ev.html](http://www.afdc.energy.gov/afdc/vehicles/electric_basics_ev.html)





<sup>16</sup> U.S. Department of Transportation, Federal Highway Administration. *Our Nation's Highways: 2008*. Available at [http://www.fhwa.dot.gov/policyinformation/pubs/pl08021/fig4\\_5.cfm](http://www.fhwa.dot.gov/policyinformation/pubs/pl08021/fig4_5.cfm).

<sup>17</sup> U.S. Department of Energy, Alternative Fuels & Advanced Vehicles Data Center. *Hybrid Electric Vehicles*. Available at [http://www.afdc.energy.gov/afdc/vehicles/electric\\_basics\\_hev.html](http://www.afdc.energy.gov/afdc/vehicles/electric_basics_hev.html)

these vehicles. HEVs cannot be charged through a plug connection. They offer better fuel economy than conventional internal combustion vehicles but otherwise function like traditional vehicles. Because HEVs do not have the same infrastructure and policy needs as plug-in vehicles, they are not the focus of this report.

The benefits of these three types of vehicles—in terms of fuel economy, emissions reductions, fuel cost savings, and fueling flexibility—are presented in Table 2-1. All-electric vehicles have the greatest fuel cost savings and the least fuel flexibility.

**Table 2-1**  
**Benefits of EVs**

What are the Benefits of Electric Drive Vehicles?			
Benefits	Hybrid Electric Vehicles	Plug-In Hybrid Electric Vehicles	All-Electric Vehicles
<b>Fuel Economy</b> 	<b>Better than similar conventional vehicles</b> The fuel savings of driving a Honda Civic Hybrid versus a conventional Civic is about 38% in the city and 20% on the highway.	<b>Better than similar HEVs and conventional vehicles</b> PHEVs use 40% to 60% less petroleum than conventional vehicles and permit driving at slow and high speeds using only electricity.	<b>No liquid fuels</b> Fuel economy of EVs is usually expressed as cost per mile, which is discussed below.
<b>Emissions Reductions</b> 	<b>Lower emissions than similar conventional vehicles</b> HEV emissions vary by vehicle and type of hybrid power system. HEVs are often used to offset fleet emissions to meet local air-quality improvement strategies and federal requirements.	<b>Lower emissions than HEVs and similar conventional vehicles</b> PHEV emissions are projected to be lower than HEV emissions, because PHEVs are driven on electricity some of the time. Most categories of emissions are lower for electricity generated from power plants than from vehicles running on gasoline or diesel.	<b>Zero emissions</b> EV emissions do not come from the tailpipe, so EVs are considered zero-emission vehicles. However, emissions are produced from the electric power plant. Most categories of emissions are lower for electricity generated from power plants than from vehicles running on gasoline or diesel.
<b>Fuel Cost Savings</b> 	<b>Less expensive to operate than a conventional vehicle</b> Because of their improved fuel economy, HEVs usually cost \$0.05 to \$0.07 per mile to operate, compared to conventional vehicles, which cost \$0.10 to \$0.15 per mile to operate.	<b>Less expensive to operate than an HEV or conventional vehicle</b> When operating on electricity, a PHEV can cost \$0.02 to \$0.04 per mile (based on average U.S. electricity price). When operating on gasoline, the same vehicle can cost \$0.05 to \$0.07 per mile, compared to conventional vehicles, which cost \$0.10 to \$0.15 per mile to operate.	<b>Less expensive to operate than conventional vehicles</b> EVs operate using only electricity. A typical electric vehicle costs \$0.02 to \$0.04 per mile for fuel (based on average U.S. electricity price).
<b>Fueling Flexibility</b> 	<b>Same as conventional vehicles</b>	<b>Can get fuel at gas stations or charge at home or public charging stations</b>	<b>Can charge at home or public charging stations</b>

Source: Alternative Fuels and Advanced Vehicles Data Center, [www.afdc.energy.gov/afdc/vehicles/electric\\_benefits.html](http://www.afdc.energy.gov/afdc/vehicles/electric_benefits.html)

## **CURRENTLY AVAILABLE EV AND PHEV MODELS**

The most popular light duty EVs currently available in the United States are the Nissan LEAF EV and the Chevy Volt PHEV. Both entered the market in December 2010. As of May 2012, nearly 12,000 LEAFs and more than 13,000 Volts had been sold nationwide. The Toyota Prius Plug-in Hybrid entered select markets in February 2012, with about 2,500 sold in the first three months of availability. The Prius PHEV is expected to be released nationally in 2013. The Fisker Karma PHEV provides an EV option in the luxury car category. Details and photos of the LEAF, the Volt, and the Prius PHEV are presented below. Additional information on vehicle models, some of which will be available in the near future, is provided in Appendix D.

### **Nissan LEAF**

**Fuel:** electric (dedicated)

**Class:** sedan/wagon

**Estimated Range:** 72 miles per charge

**Battery:** li-ion

**Emission Certification:** California ZEV, Tier 2 Bin 1

**Engine:** 80 kW e-motor

**Availability:** nationwide



### **Chevrolet Volt**

**Fuel:** plug-in hybrid electric (hybrid electric)

**Class:** sedan/wagon

**Fuel Economy:** 95 MPGe city, 93 MPGe highway

**Estimated Electric Range:** 35 miles per charge

**Battery:** li-ion

**Emission Certification:** SULEV

**Engine:** 4-cyl, 1.4L, 111 kW e-motor

**Availability:** nationwide



### **Toyota Prius Plug-in Hybrid**

**Fuel:** plug-in hybrid electric (hybrid electric)

**Class:** sedan/wagon

**Fuel Economy:** 87 MPGe city

**Estimated Electric Range:** 15 miles per charge

**Battery:** li-ion

**Emission Certification:** California AT PZEV, Tier 2 Bin 3

**Engine:** 4-cyl, 1.8L, 60 kW e-motor

**Availability:** select states, including Maryland and Virginia



## CHARGING EQUIPMENT

Different types of charging equipment are now available, and charging performance will likely continue to improve. EVs are charged by plugging into special charging equipment, generally referred to as electric vehicle supply equipment (EVSE). Charging time can range from 30 minutes to 20 or more hours, depending on a number of factors, including current, battery capacity and chemistry, and the battery's state of charge. Three main EVSE classes are available today—Level 1, Level 2, and DC fast charge. Level 3 charging is not yet available to consumers. All four classes of charging equipment are described below.

**Level 1 Charging.** Level 1 EVSE uses a cord similar to a household extension cord to provide charging. On one end is a three-prong, 120-volt AC plug, and on the other is a J1772 standard connector to connect with the vehicle. Level 1 charging is typically used in residential settings when a higher-voltage circuit is not available. However, it is an economic and effective solution for any nonresidential location that wishes to make EV charging infrastructure available. Level 1 charging is particularly effective at locations where EV owners will park for long periods of time, such as the workplace. Level 1 charging is also well-suited to any location that wants to offer EV owners the ability to “top off” their batteries. Level 1 cordsets are typically included with the vehicle purchase and simply require access to a standard 120-volt outlet. The charging rate is generally two to five miles of range per hour of charging.

**Level 2 Charging.** Rather than using a standard plug, Level 2 EVSE requires installation of hardwired home charging or public charging equipment. It requires a 240-volt AC plug and a dedicated 40-amp circuit. Level 2 charging also uses a J1772 connector to connect to the vehicle. This equipment charges a typical EV battery overnight, and because most homes have 240-volt service available, Level 2 charging is expected to become the predominant residential charging method. It is also common at public charging stations. The charging rate is approximately 10 to 20 miles of range per hour of charging.

**Level 3 Charging.** This charging type is still in development but is expected to provide a faster AC charging option at public stations. It would operate at a higher voltage and current than Level 2 EVSE. Level 3 charging is expected to deliver a full charge in less than 30 minutes.

**DC Fast Charging.** Direct-current (DC) fast charging uses a 480-volt connection to provide 50kW or more to EV batteries. It provides a full charge in less than 30 minutes, enabling charging along heavy traffic corridors and at public charging stations. The first generation of DC fast chargers primarily uses the CHAdeMO connectors, produced in Japan. However, in May 2012 the International Society of Automotive Engineers (SAE) developed a new plug design as the standard for American and European models. The new design, called DC Fast Charging with

a Combined Charging System, offers a single port that is compatible with existing Level 1 and 2 plugs.



J1772 Connector. Photo: ITT Interconnect Solutions  
CHAdeMO Connector. Photo: EVWorld



Combined Charging System. Photo:  
[http://media.gm.com/media/us/en/gm/news.detail.html/content/Pages/news/us/en/2012/May/0503\\_combocharging.html](http://media.gm.com/media/us/en/gm/news.detail.html/content/Pages/news/us/en/2012/May/0503_combocharging.html)

Characteristics of these four charging options are detailed in Table 2-2. DC fast charging has the greatest potential for charging efficiencies.

**Table 2-2**  
**EVSE Options**

EVSE Options						
	Current Type	Amperage (amps)	Voltage (V)	Kilowatts (kW)	Charging Time (for fully depleted battery)	Primary Use
Level 1	Alternating current (AC)	Up to 15 amps	120V	Up to 1.8 kW	6 to 20 hours	Residential charging
Level 2	AC	Up to 80 amps	240V	Up to 19.2 kW	3 to 8 hours	Residential and public charging
Level 3 (in development)	AC	To be determined	To be determined	To be determined	Under 30 minutes	Public charging
DC Fast Charging	Direct current (DC)	Up to 200 amps	480V	50 to 150 kW	Under 30 minutes	Public charging

Source: Alternative Fuels and Advanced Vehicles Data Center, [www.afdc.energy.gov/afdc/vehicles/electric\\_charging\\_equipment.html](http://www.afdc.energy.gov/afdc/vehicles/electric_charging_equipment.html)

**EVSE MANUFACTURERS AND NETWORK DEVELOPERS**

Fortunately, there is a robust and growing market of EVSE suppliers. The EVSE market is expected to grow to \$372 million in the United States by 2015.<sup>18</sup> The market is expanding rapidly, with dozens of active EVSE manufacturers and suppliers and hundreds of charging equipment models available. Typically, different charging equipment is used in home, multiunit residential, on-street public, retail/commercial, and fleet-charging settings. Two common designs are the free-standing “pedestal” and the wall-mounted charger.



*Plug-In 2011 Conference & Exposition, Raleigh, NC*

<sup>18</sup> Pike Research. *EV Charging Growing More Complex*. August 4, 2010, by John Gartner. Available at <http://www.pikeresearch.com/blog/articles/ev-charging-growing-more-complex>

## Major Players in the EVSE Market

- **350Green** partners with EVSE manufacturers, original equipment manufacturers (OEMs), municipalities, and site hosts to develop EV charging networks in major cities. The company works on site selection, engineering, construction, and marketing for charging infrastructure networks. It was an initial partner in The EV Project, which is described in the paragraph on ECotality below.
- **Aerovironment**, also known as AV, produces high-power test systems and EV charging stations. It provides charging products for a range of applications, including home, multiunit residential, public, fleet, commercial, and workplace. The company also provides installation services and business system integration.
- **Better Place** provides comprehensive EV network services. The company develops battery switch stations, charging networks, EV network monitoring software, and EV driver software. The company recently partnered with General Electric to accelerate EV infrastructure deployment.
- **Coulomb Technologies** was an early entrant in the EVSE market but is now moving away from hardware manufacturing and toward management of its charging network. Coulomb sells subscriptions for access to its nationwide ChargePoint network. The company has received a \$15 million U.S. Department of Energy (DOE) grant to support EVSE deployment in nine regions across the country. The program will support deployment of up to 4,600 charging stations.
- **ECotality** is currently managing The EV Project, a \$115 million DOE grant to set up charging networks in 16 cities. It will be the largest deployment of EVs and EVSE to date. ECotality's charging infrastructure is branded as the Blink Network.
- **Eaton Corporation**, a well-established power equipment manufacturer, recently began producing EVSE. The company has partnered with Gridpoint to provide infrastructure services and aggregate data from its EVSE locations.
- **General Electric** has developed the WattStation EV charger as well as the WattStation Connect mobile app, which allows users to locate charging stations, check on availability and charging status, and pay for charging services.

- **Leviton**, which manufactures electrical wiring devices, data center connectivity products, and lighting energy management, has recently entered the EV charging market. Its Evr-Green product line provides EVSE for residential, commercial, and public charging.
- **NRG Energy** is now building out the eVgo Charging Network in Houston, which will be the first privately funded, comprehensive EV charging network in the country. NRG aims to provide complete range confidence by building up to 150 charging stations across the Houston metropolitan area. Customers will pay a flat monthly fee to access charging anywhere in the network. The eVgo network also operates in the Dallas/Fort Worth area and may expand to other markets in the future.
- **Siemens** offers a number of EV charging station models to municipalities, corporations, fleets, and utilities. They offer multilevel charging, meaning that both Level 1 and Level 2 charging are supported.

There is a strong emerging market for EVs, charging equipment, and related services. The challenge for the metropolitan Washington region is to identify regional obstacles to significant local deployment and to work to make the region attractive for prospective EV owners, manufacturers, and service providers. The next section looks specifically at the current state of the local EV charging market—what drives decisions as to where to locate EV charging stations and local efforts to promote the deployment of this technology.



## SECTION 3

### EV and EVSE DEPLOYMENT PLANNING

A growing electric vehicle (EV) charging infrastructure exists in the metropolitan Washington region as a result of stimulus funding through state governments and private investment. To facilitate EV deployment in the region, investment in EV charging stations should address the needs of EV owners—otherwise, the investments made will go unused and EVs will continue to represent a small minority of vehicles on the road.

Driving behavior and EV ownership in the region are important factors to consider in making decisions about investing in electric vehicle supply equipment (EVSE). Experience in regions that have developed EV infrastructure indicates that most EV charging is done at home. The next most frequent location for charging is at major places of employment.

Household travel demand and EV ownership in the region are important factors to consider in deciding where and how many charging stations to locate at places of major employment, retail, public facilities, and entertainment destinations. Some data on these factors are presented in this report, but more analysis is needed. The Task Force addressed the question of where EV infrastructure should be located and considered the challenges of providing destination charging and access to charging for residents of multiunit buildings.

This section presents baseline information on the outlook for EV ownership and number of charging stations along with general site location recommendations. Deployment planning strategies are presented with a preliminary regional needs analysis, along with best practices and examples to improve the network going forward. This section's recommendations include promoting strategic EVSE siting, reducing EVSE installation costs, and using incentives to promote investment in publicly accessible charging stations.

#### EV OWNERSHIP

##### Outlook for EV Markets

As Corporate Average Fuel Economy (CAFE) standards increase, automobile original equipment manufacturers (OEMs) are investing more in EVs. In July 2011, President Obama announced that vehicle manufacturers would be required to meet a

fleet-wide average fuel economy of 55 mpg by 2025. To meet a fleet-wide average fuel economy of 35.5 mpg in 2016, manufacturers are releasing more high-efficiency vehicles. Since

##### Summary: Factors Affecting EV Demand

*Global:* gasoline prices

*National:* federal grants, CAFÉ standards, tax credits

*Regional:* electricity prices

*State & Local:* incentives and requirements

*Consumer/Purchaser:* cost, range, availability of EV models and availability of charging infrastructure

2009, the number of subcompact vehicles rated at least 30 mpg has tripled and large increases have also been seen in the midsize and crossover categories.<sup>19</sup> EVs, which offer ratings of 75 to over 100 miles per gallon equivalent (MPGe), will play an increasingly important role in auto manufacturers' fleets as they seek to meet the ambitious 2025 goal.<sup>20</sup>

While interest in EVs is growing, the EV market share has not grown significantly over the past five years. Since 2007, the yearly proportion of EVs out of all vehicles sold has hovered between two and three percent.<sup>21</sup> In that time, 1.3 million EVs have been sold, including hybrid, plug-in hybrid, extended-range, battery, and fuel cell vehicles.<sup>22</sup>

Industry experts suspect that constraints on the availability of the most popular models, the Nissan LEAF EV and the Chevy Volt plug-in hybrid electric vehicle (PHEV), have held back growth in the EV segment in recent years. In 2011, the LEAF was available in only 30 states, and all cars produced that year were claimed by preorders from 2010. This left only a few unclaimed preorders available to car shoppers that year. Chevrolet also did not begin offering the Volt nationally until fall 2011. As the roll-out progressed, sales have increased. Both companies have announced higher production for 2012, which is expected to open the market to additional growth.<sup>23</sup>

In addition, limited vehicle selection is attributed to low growth rates in this sector. Compared with the wide array of model types in the internal combustion sector, only two EV models are now available nationally. A number of new EV models are expected for national rollout in 2013 and 2014, however, which should further open the market. See Section 2 and Appendix D for more detail on OEM vehicle offerings.

OEMs are currently offering the Nissan LEAF and Chevy Volt in the metropolitan Washington region. PHEVs such as the Toyota Prius are also being sold in the region. Fitzgerald Toyota in Gaithersburg, Maryland, offers a service to convert the standard Prius to a PHEV. Starting in April, Toyota also began to offer the PHEV Prius at the point of sale.

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<sup>19</sup> Natural Resources Defense Council. *Relieving Pain at the Pump*. May 2, 2012. Available at <http://www.nrdc.org/energy/relievingpainatthepump.asp>

<sup>20</sup> U.S. Department of Energy. *2011–12 Electric Vehicles*. Available at <http://www.fueleconomy.gov/feg/evsbs.shtml>

<sup>21</sup> Electric Drive Transportation Association. *Electric Drive Vehicle Sales Figures (U.S. Market)*. Available at <http://electricdrive.org/index.php?ht=d/sp/i/20952/pid/20952>

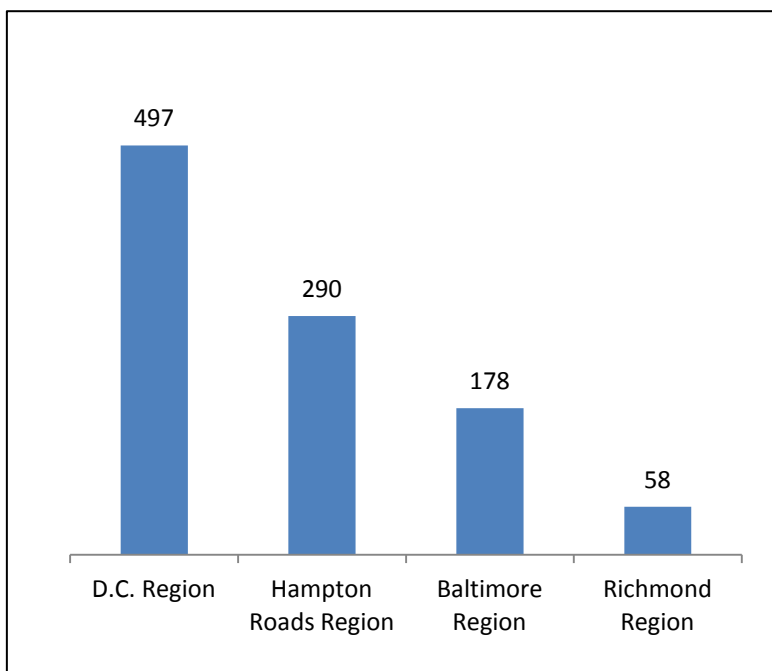
<sup>22</sup> Electric Drive Transportation Association. *Electric Drive Vehicle Sales Figures (U.S. Market)*. Available at <http://electricdrive.org/index.php?ht=d/sp/i/20952/pid/20952>

<sup>23</sup> Edmunds.com. *Upcoming Revenge of the Electric Car? The Potential for Higher EV/PHEV Sales*. Available at <http://www.edmunds.com/industry-center/commentary/upcoming-revenge-of-the-electric-car.html>

### Regional Forecast for EV Ownership

There is no way to accurately predict the number of EVs that will be operating in the region in the next two, five, or 10 years or where to site EVSE to best accommodate potential future charging needs. Currently, there are approximately 500 EVs registered in the metropolitan Washington region (see Figure 3-1). As of 2009, there were believed to be approximately 57,000 EVs in operation nationwide.<sup>24</sup> The U.S. Department of Energy (DOE) projects that there could be 1.2 million EVs on the road by 2015.<sup>25</sup>

**Figure 3-1**  
**Electric Vehicle Registrations (as of June 2012)**



Source: DMV Registration Data.

One approach to predicting future EV demand is to analyze the experience of early adopters of hybrid vehicles. COG staff analyzed registration data available from the Transportation Planning Board (TPB) from 2005 to 2011. In just six years, the number of registered hybrid vehicles grew by more than 600 percent. However, total registered hybrid vehicles in the region still represent approximately 1.5 percent of all vehicle registrations. Figure 3-2 shows the growth of hybrid vehicle registrations in the District of Columbia, Maryland, and Virginia.

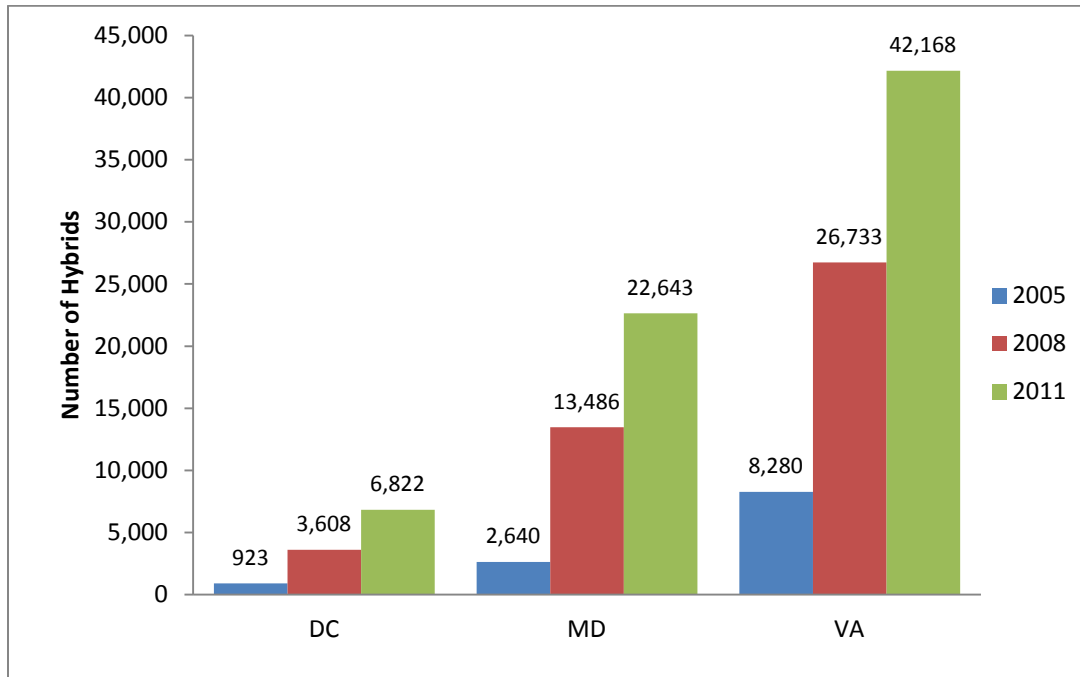
<sup>24</sup> U.S. Energy Information Administration. *Frequently Asked Questions*. Available at <http://www.eia.gov/tools/faqs/faq.cfm?id=93&t=4>

<sup>25</sup> U.S. Department of Energy. *One Million Electric Vehicles by 2015*. February 2011. Available at [http://www1.eere.energy.gov/vehiclesandfuels/pdfs/1\\_million\\_electric\\_vehicles\\_rpt.pdf](http://www1.eere.energy.gov/vehiclesandfuels/pdfs/1_million_electric_vehicles_rpt.pdf)

Virginia’s higher hybrid vehicle registration is in part due to incentives in 2005–2006 allowing hybrids to use HOV lanes.<sup>26</sup>

**Figure 3-2**

**Washington Area Hybrid Vehicle Registration for 2005, 2008, and 2011**



Source: DMV Registration Data.

Using the most conservative estimate of regional EV adoption by 2015–2020, if EVs experience a 600% increase in five years—mirroring the rate of adoption of hybrids—the region could have 1,500 to 3,000 EVs operating on the roadways (up from the current number of approximately 500 vehicles). As a high estimate, if total EV sales in the next eight to 10 years reach fleet levels comparable to current levels of hybrids, the region could see anywhere from 50,000 to 75,000 EVs operating on the roadways by 2020.

COG staff was also able to document generally where the early adopters of hybrid vehicles are located. Early adopters may be found in clusters, with potentially higher concentrations residing in Fairfax and Montgomery counties, in inner ring suburbs, and in the District of Columbia.

<sup>26</sup> These incentives are no longer available to new hybrid owners due to congestion along I-95/395 and I-66. The original privileges were grandfathered in for earlier hybrid vehicles with Clean Car Virginia licenses.

## **FACTORS IMPACTING EV ADOPTION AND LOCATION**

The potential need for public/private charging infrastructure siting can be informed by examining a variety of regional characteristics and trends. The following are some factors relevant to the metropolitan Washington region:

- Data on housing type (i.e., the number and distribution of households with and without access to private driveway or garage) indicate the location of home charging stations and the need for multifamily, EV car-share, workplace, or other destination infrastructure.
- Data on the location of hybrid vehicle owners and on households with higher income indicate possible locations of early EV adopters.
- Location of workplaces with 20–40 mile vehicle commutes<sup>27</sup> can be useful because commutes of 20–40 miles are good EV candidates. Shorter commutes can be made on one charge; longer commutes may be out of the range of one battery charge for some EVs.
- Identifying households with more than one vehicle can be useful because for early adopters, EVs are more likely to be feasible for households with two or more cars.
- It's helpful to know the distribution of vehicle trips across the central core, inner suburbs, outer suburbs, and outer ring<sup>28</sup> because EV charging infrastructure demand might follow similar patterns.
- The number of vehicle trips to nonwork and nonhome destinations indicates popular recreational and retail destinations.
- Length of vehicle trips by destination indicates the relationship of trip length to vehicle charging needs.

## **REGION'S VEHICLE OWNERSHIP AND TRAVEL PATTERNS**

EVs have the potential to be effectively deployed to meet the transportation needs of the population in the region. Data from the COG Household Travel Survey and Travel Demand Model indicate that most trips in the region are relatively short and are associated with destinations that would be good candidates for charging solutions—workplace, shopping, schools, and recreational sites.<sup>29</sup> For most daily commutes and other trip purposes, the relatively

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<sup>27</sup> Metric used by Western Washington Clean Cities Coalition, available at <http://www.wwcleancities.org/index.html>

<sup>28</sup> COG DTP, 2009. Presentation of Some Initial Findings by Robert E. Griffiths, Technical Services Director to the National Capital Region Transportation Planning Board, Metropolitan Washington Council of Governments, January 28, 2009. Available at [http://www.mwcog.org/committee/committee/archives.asp?COMMITTEE\\_ID=15](http://www.mwcog.org/committee/committee/archives.asp?COMMITTEE_ID=15)

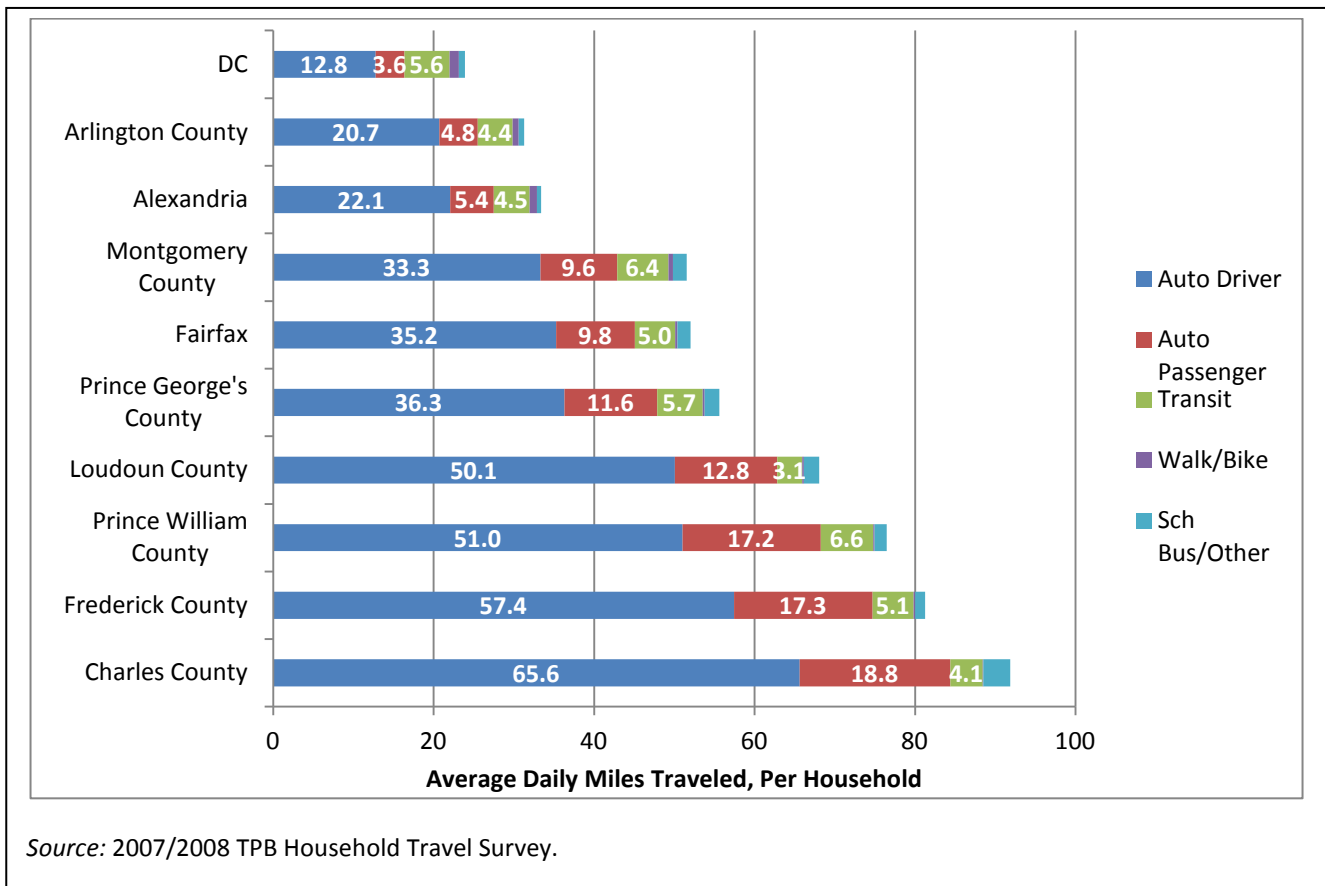
<sup>29</sup> COG's Household Travel Survey is based on a random sample of about 10,000 households inquiring when, where, how, and why people travel. Survey respondents complete a 24-hour travel diary, noting mode of transport, number of trips, destination, and length in time and distance for each trip taken. This information is used in transportation planning, such as development of predictive demand travel forecasting models. Survey findings are informative in planning for EVs. The Household Travel Survey statistics reported here are based on the most recently completed survey, conducted in 2007–2008.

short length of the trips would not cause significant range anxiety. In the near term, the region may experience higher adoption rates in the inner suburbs and core, in areas with relatively high household income, and in households with multiple cars. Appendix E contains more information on travel patterns and household travel demand in the region.

The region is heavily reliant on vehicle travel to reach destinations. Approximately 60 percent of trips identified in the Household Travel Survey were auto-oriented trips that could potentially be served by EVs in the future.

As Figure 3-3 illustrates, the proportion of trips made by auto varies by jurisdiction in the COG region, as does the average daily miles traveled per household. Many of the region’s households have access to more than one vehicle, and Figure 3-3 does not indicate how trips are chained. Nevertheless, the daily mileage indicates that core and inner jurisdictions could fulfill daily travel needs by EV on one charge, although EV drivers in outer jurisdictions may need to charge at workplace or recreational destinations before returning home.

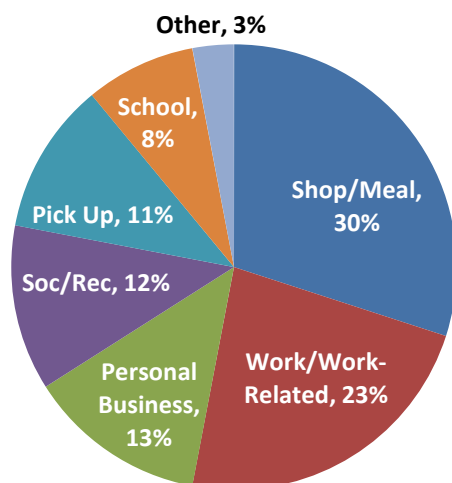
**Figure 3-3**  
**Average Daily Miles Traveled per Household by Jurisdiction and Mode**



According to the Household Travel Survey, most vehicle trips in the region are relatively short, with an average vehicle trip length of 7.7 miles. This is well within the range of one charge for most vehicles. Therefore, for most daily commutes and other trip purposes, the relatively short length of the trips would not cause significant range anxiety.

Figure 3-4 suggests travel destinations that would be good candidates for charging solutions—workplace, shopping, schools, and recreational sites.

**Figure 3-4**  
**Travel Destinations in the Region**



*Note:* Work/Work-Related includes trips to work, trips to work after other stop, and work-related trips.

*Source:* 2007/2008 TPB Household Travel Survey.

**Regional Activity Centers** are determined by current local comprehensive plans and zoning approved to accommodate existing and future employment and housing growth. They are largely based on employment concentrations and to a lesser extent on residential, transit, and cultural activities.  
<http://www.regionforward.org/overview>

**Trips to Work**

Most automobile commuting trips in the region—55 percent—end in one of the metropolitan area’s Regional Activity Centers (see sidebar). A high proportion of these commuting trips—91 percent—are shorter than 20 miles one way. A small proportion of auto commute trips—1.3 percent—are longer than 40 miles. This suggests that EVs could serve the needs of most daily work commuters headed to Regional Activity Centers.

**Trips for Shopping**

Shopping also involves a significant number of automobile trips that are less than 20 miles—96 percent. EVs could be accommodated by home charging or car-share charging, with some retail charging locations helpful as a backup or for drivers who conduct more than one trip on a charge.

**Trip Length and EV Range**

Electric-only and hybrid-electric models available in the region that could reasonably rely on electric fuel alone are designed to travel from 56 to 72 miles on one charge. A fairly conservative rule of thumb for EV range is 20 miles one way, although some models handle much longer journeys, depending on driving conditions. The range of EV models that are available in the region is listed in Table 3-1.

**Table 3-1  
Range of EV Models Available in the Metropolitan Washington Region**

Vehicle	Range per charge (in miles)
<b>Electric-only</b>	
Nissan LEAF	72
<b>Hybrid electric</b>	
Chevy Volt	35
Toyota Prius	15
Fisker Karma	50

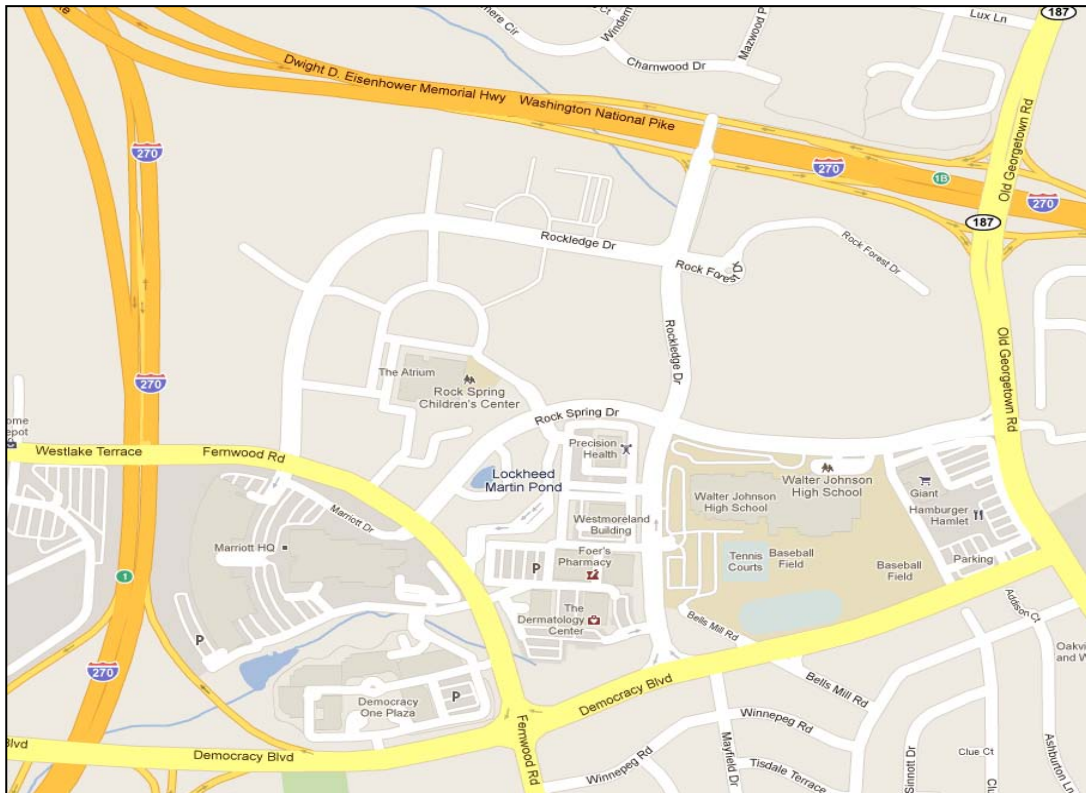
Source: Alternative Fuels and Advanced Vehicles Data Center, [http://www.afdc.energy.gov/vehicles/search/light/autos?fuel\\_type\\_code=ELEC](http://www.afdc.energy.gov/vehicles/search/light/autos?fuel_type_code=ELEC)

**Small Area Case Study: Highway 270 and Democracy Boulevard in Maryland**

COG transportation staff conducted a sample siting analysis for EV infrastructure for illustrative purposes, using data from the 2007/2008 Household Travel Survey. Transportation Analysis Zones (TAZs) with the highest number of home-to-work trips made by car were identified. The zone in the region with the greatest number of these trips that was not a major military installation was found to be north of Bethesda in Montgomery County, Maryland. Zone 702, shown in Figure 3-5, exhibits several factors that indicate potential for charging station demand.



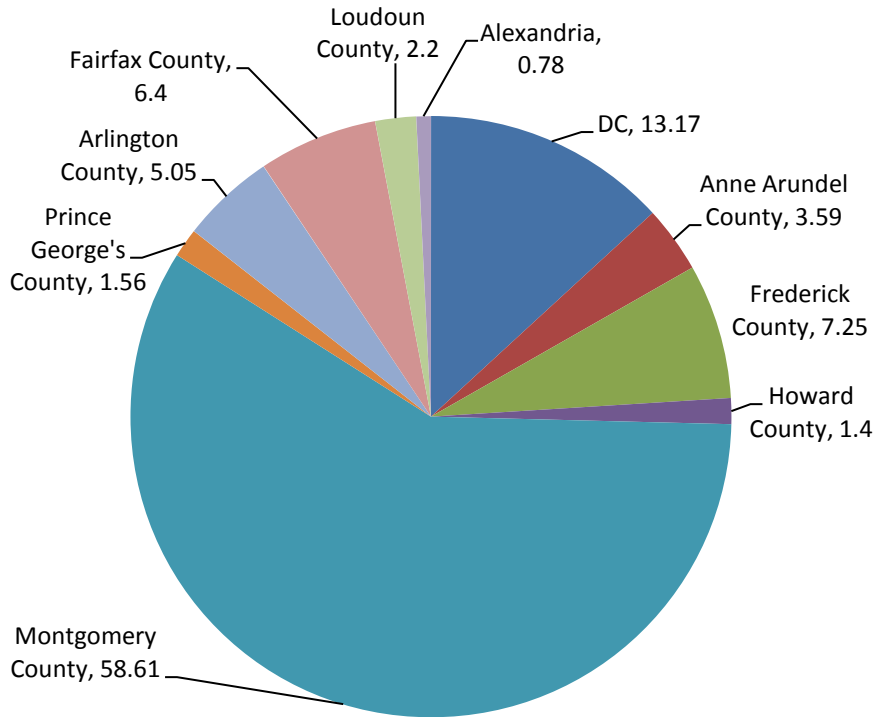
**Figure 3-5**  
**Transportation Analysis Zone 702**



Source: googlemaps.com

Zone 702 is difficult to access other than in a private vehicle, and it contains major employers with whom local governments could partner to encourage EV usage. In addition, most workers live within 20 miles of their workplace, about the current EV range (see Figure 3-6). If commuters had access to charging stations in this area, even workers who did not have access to a private driveway or private garage could potentially commute via EV. Currently, there is just one publicly accessible charging station in the area, which is located at the SunTrust Bank at Democracy Boulevard and Old Georgetown Road, with three Level 2 chargers. Areas with these characteristics could be targeted with policies to encourage installation of additional stations, while not inducing proportionally more vehicle trips.

**Figure 3-6**  
**Breakdown of Where Workers of TAZ 702 Live**



*Note: 77% of workers who drive live within the 20-mile EV range of TAZ 702.*

## EVSE SITE LOCATIONS

For plug-in electrical vehicle (PEV) owners, most charging will likely occur at home, with workplace charging a close second. Multifamily and urban dwellers without a dedicated garage or driveway will require innovative charging solutions. Public charging should be provided in strategic locations on the basis of driver lifestyle destinations—shopping, theater, hairdresser, Park & Ride, and so forth. EV car-sharing and rental programs provide additional opportunities for non-PEV owners.

This subsection identifies considerations and recommendations for deploying EV

charging stations or EV infrastructure in specific site types. Many sources recommend taking an adaptive approach—laying the groundwork in new development and redeveloping areas for future infrastructure capability. Figure 3-7 lists the suitability of different types of charging stations for different vehicle uses and locations. The discussion below highlights the advantages and challenges of various EV charging location sites.

### Homes

Homes—where a vehicle spends 8–12 hours parked—will see the highest demand for charging. The relative suitability for EV use of different types of homes is discussed below:

- **Single family homes** that have garages or driveways are the most straightforward locations. As shown in Figure 3-8, single-family home ownership is common in many regional jurisdictions. A local permit may be required if an EV charging unit is installed.
- **Town homes** without garages or driveways will have special charging station location needs.
- **Apartments/condominiums** and other multiunit dwellings have particularly difficult challenges due to limited and/or shared parking and lack of access to electrical conduits. Multifamily residential units vary in their needs regarding EV infrastructure implementation. Homeowners associations may need to be educated about EV charging stations, their requirements, and how to locate them.

As part of their *Park and Charge Pilot Program*, the District of Columbia installed the first public curbside electric vehicle charging station in the United States at the intersection of 14<sup>th</sup> & U St., NW, in 2010 in partnership with ChargePoint America and Pepco and partially supported by federal grants. Between installation and April 2012, the station was utilized for 135 charging sessions. The District plans to open at least two more stations at Washington Canal Park in May 2012.



Source: The District of Columbia Department of Transportation. *Park and Charge Pilot*. Available at <http://ddot.dc.gov/DC/DDOT/Services/Parking+Services/View+All/Park+and+Charge+Pilot>

## Work

Workplaces—where vehicles spend typically 6–10 hours parked—may be another widely used location for charging EVs, behind home charging. Workplace charging provides opportunities to attract high-quality employees and present an innovative image.

Work-related destinations may also include office parks, hotels (business trips), institutions and universities, convention centers, hospitals, fleet depots and motorpools, nonprofits, and Park & Ride lots. The Task Force found that many building owners and operators are uninformed about EV charging station installation requirements. Some workplaces have limited parking. Building owners may need to consider permitting, parking lot management, and turnover of charging parking spaces. Surface parking lots and garages have different site-level issues.

### Figure 3-7. Charging Location Guidelines by Charging Level Type

—adapted from The EV Project

#### Level 1 Locations—Full charge up to 24 hours

##### Residential Locations

- Lightly traveled BEVs, PHEVs
- All night charging available

##### Workplace Locations

- All day charging available

##### Emergency Use

- Carry converter in trunk for backup use with any compatible electric socket

#### AC Level 2 Location—Full charge 4 to 6 hours

##### Destination Locations

- Where people shop, play, gather
- Target is 1–3 hour stays
- Expand effective operating range
- Higher turnover

##### Workplace Locations

##### Parking Garages

#### DC Fast Charging—Full charge 20–30 minutes (None yet available in Washington area)

##### Destination Locations

- Short stops: convenience stores, fast food, rest stops
- Target is 15–30 minute stays
- “Safety net” locations
- Serve “garageless” EV owners

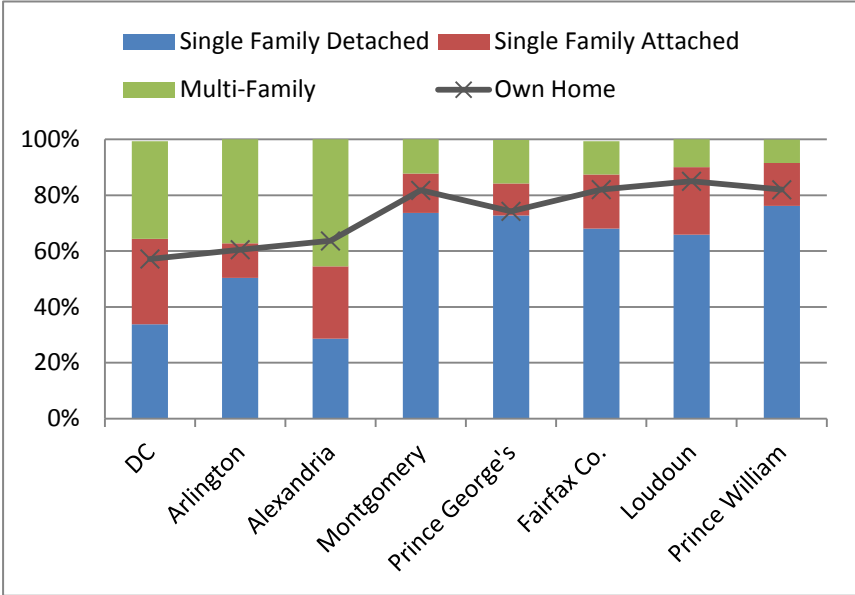
##### Freeway Corridors

##### Typically High Traffic Areas

Source: Idaho National Laboratory. *U.S. Department of Energy’s Vehicle Technology Program: Clean Cities Webinar—Charging Infrastructure Micro Climate Process and Data Collection*. Presentation by Stephen Schey and Jim Francfort, June 21, 2010. Available at

[http://www1.eere.energy.gov/cleancities/toolbox/pdfs/ev\\_charging\\_infrastructure.pdf](http://www1.eere.energy.gov/cleancities/toolbox/pdfs/ev_charging_infrastructure.pdf)

**Figure 3-8  
Housing Type by Jurisdiction**



*Note:* A majority of residents in DC and Alexandria live in multifamily or single family attached housing, while single family home ownership is common in other jurisdictions.

*Source:* 2007/2008 Household Travel Survey.

**Amenities and Recreation Destinations**

Vehicles spend typically 1+ hours at amenities and recreation destinations, which are the third-most-used location. Amenities destinations include surface parking lots or garages, shopping malls or other retail locations, cultural centers, restaurants, sporting venues, universities, curbside in cities, parks and recreation areas, airports, gas stations, and rest stops. Issues to consider when locating EV charging stations include permitting, training and education on technical installation practices, and parking space turnover management (less applicable than at workplaces). Gas stations and rest stops are feasible only if they are adjacent to other uses or are designed for long stays, such as mixed-use locations. EV dealerships are also advantageous locations for charging stations.

**Public Facilities**

Charging stations at public facilities, where vehicles spend 1+ hours, can be positioned to complement existing privately financed stations. Public facilities that could support charging stations include city halls, libraries, courthouses, town squares, and other public institutions. Beyond serving their employees, charging stations that serve customers in public facilities can educate vehicle owners and reduce range anxiety, assisting in kick-starting the market. Public

facilities charging stations can demonstrate the feasibility and highlight the air quality benefits of EVs. Charging stations that serve on-street parking in the right-of-way is a special case that poses significant cost barriers and site-survey needs in order to access the power source and meet the requirements for a second utility meter (see Section 4 on Local Government Policy).

### **Car Rental and Car Sharing**

Vehicles spend varying amounts of time parked at car rental and car-sharing facilities. These locations can provide unique educational opportunities and space-efficient solutions for travelers and urban dwellers. Rental and car-sharing charging stations could be located in car share parking spots (i.e., Zipcar), rental car depots, tourist or business destinations, and area hotels. See Appendix F for more information on car-sharing programs in the region.

EV car rental and EV car sharing are well-suited for shorter travel and errands. The Task Force sees a potential business model for a network of EV charging stations for business travelers and tourists. This system would require special agreement between rental car operators, hotels, and attractions.

Car sharing can help meet the needs of multifamily dwelling residents without increasing the need for parking spaces. Car sharing and car rental can produce additional benefits by allowing drivers to experience an EV and how it operates, serving as a stepping stone for future EV use. Table 3-2 lists the opportunities and challenges for EV charging stations that are posed by different site types.

**Table 3-2**  
**Summary of Opportunities and Issues by Site Type**

<b>Location</b>	<b>Opportunities</b>	<b>Barriers/Limitations</b>
<b>Single family home (with driveway or garage)</b>	<ul style="list-style-type: none"> <li>• Highest charging demand</li> </ul>	<ul style="list-style-type: none"> <li>• Many potential owners may not live in single family houses or have private driveway/garages</li> <li>• Knowledge</li> <li>• Permitting process</li> </ul>
<b>Multifamily residential</b>	<ul style="list-style-type: none"> <li>• Potentially high demand</li> <li>• Many contain parking facilities</li> <li>• Opportunity for car sharing</li> </ul>	<ul style="list-style-type: none"> <li>• Some may have limited parking spaces</li> <li>• Property owners information gap</li> <li>• Permitting process</li> <li>• Technical capability</li> <li>• Turnover management</li> <li>• Parking lot management</li> </ul>
<b>Workplace</b>	<ul style="list-style-type: none"> <li>• Potential high charging demand behind residential</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge</li> <li>• Permitting process</li> <li>• Technical capability</li> <li>• Charging turnover management</li> <li>• Parking lot management</li> </ul>
<b>Amenities and recreation</b>	<ul style="list-style-type: none"> <li>• Potential high charging demand</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge</li> <li>• Permitting process</li> <li>• Technical capability</li> <li>• Turnover management</li> <li>• Parking lot management</li> </ul>
<b>Rentals</b>	<ul style="list-style-type: none"> <li>• Capitalize on tourism market</li> <li>• Stepping stone to ownership</li> </ul>	<ul style="list-style-type: none"> <li>• Need network with rental companies, hotels, and destination parking</li> </ul>
<b>EV car sharing</b>	<ul style="list-style-type: none"> <li>• Regular car sharing already exists</li> <li>• Zipcar planning to offer a few EVs</li> </ul>	<ul style="list-style-type: none"> <li>• Permitting/technical</li> </ul>
<b>Public facilities</b>	<ul style="list-style-type: none"> <li>• Could help kick-start market</li> <li>• Demonstrate environmental responsibility</li> <li>• Improved air quality</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge</li> <li>• Permitting process</li> <li>• Technical capability</li> <li>• Charging turnover management</li> <li>• Parking lot management</li> <li>• On-street—special case</li> </ul>

## **REGIONAL PROJECTS**

Several federally stimulated initiatives are currently siting public and residential EV infrastructure in parts of the metropolitan Washington region. They include ECotality's The EV Project, Coulomb's ChargePoint America Program, Maryland Electric Vehicle Infrastructure Program (EVIP)/BEVI (Baltimore-Washington Electric Vehicle Initiative), and the Northeast Regional Electric Vehicle Network project. These projects are described below.

### **ECotality's The EV Project**

The EV Project is a \$230 million project that received \$115 million in stimulus grant funds. The project is to install 15,000 Level 2 commercial and residential charging stations across 18 cities and metropolitan areas within six states and the District of Columbia. The project is expected to install the infrastructure to support the deployment of 5,700 Nissan LEAFs and 2,600 Chevy Volts. In the metropolitan Washington region, the plan is to install residential charging stations at no cost to qualified participants. Nissan LEAF and Chevy Volt owners may apply; in exchange for allowing the collection of information about vehicle usage and charging, participants receive a Blink wall mount charger and may be eligible for a \$1,200 credit toward installation.

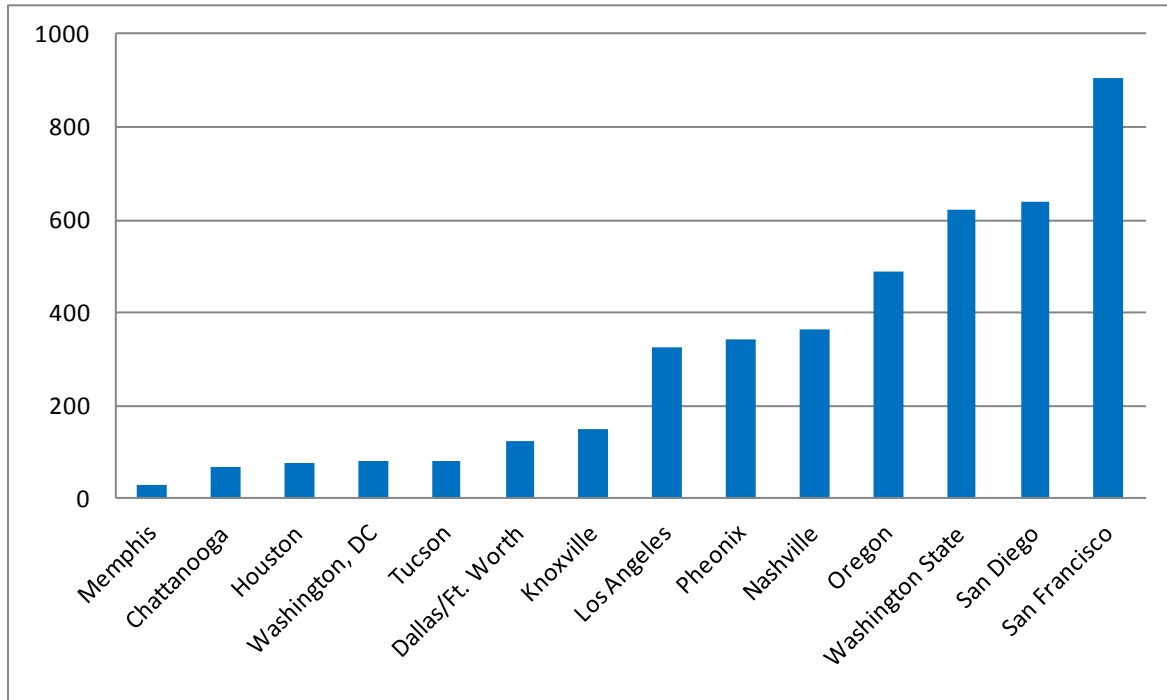
As of March 2012, The EV Project had installed 5,432 charging stations nationwide, including 83 residential Level 2 charging stations in the metropolitan Washington region. Ninety-nine Chevy Volts had been enrolled for data sharing. The metropolitan Washington region has seen a disproportionately low share of EVSE installments among participating cities. Despite being the fourth most populous metropolitan area included in the project, it ranks 11th in number of stations installed and 14th in number of stations per capita. The region has fewer than 15 EV Project stations per million residents, while the top-ranking metropolitan area, San Francisco, has 628. Figure 3-9 shows the number of charging stations installed in the 14 top-ranking metropolitan areas as of March 2012.

Between January and March 2012, there were 5,123 charging events at The EV Project charging stations in the metropolitan Washington region. These charging events consumed 32.11 AC MWh of power. Most charging occurred between 4 p.m. and midnight, with a peak at around 10 p.m. The average connection time was 10.6 hours per vehicle, but charging time averaged only two hours. Vehicles consumed an average of 6.3 AC kWh per charging event.



**Figure 3-9**

**Total EV Project Chargers Installed by Metropolitan Area Through March 2012**



Source: U.S. Department of Energy Vehicle Technology Program, <http://avt.inl.gov/pdf/EVProj/EVProjOverviewQ12012.pdf>

### **Coulomb Technologies' ChargePoint America Program**

The ChargePoint America Program is a \$37 million program made possible by \$15 million in stimulus funding. The program is in partnership with Ford, GM Chevy, and Daimler's Smart USA and is intended to support the deployment of 4,600 Coulomb public and private residential Level 2 charging stations in 12 selected regions across the country.

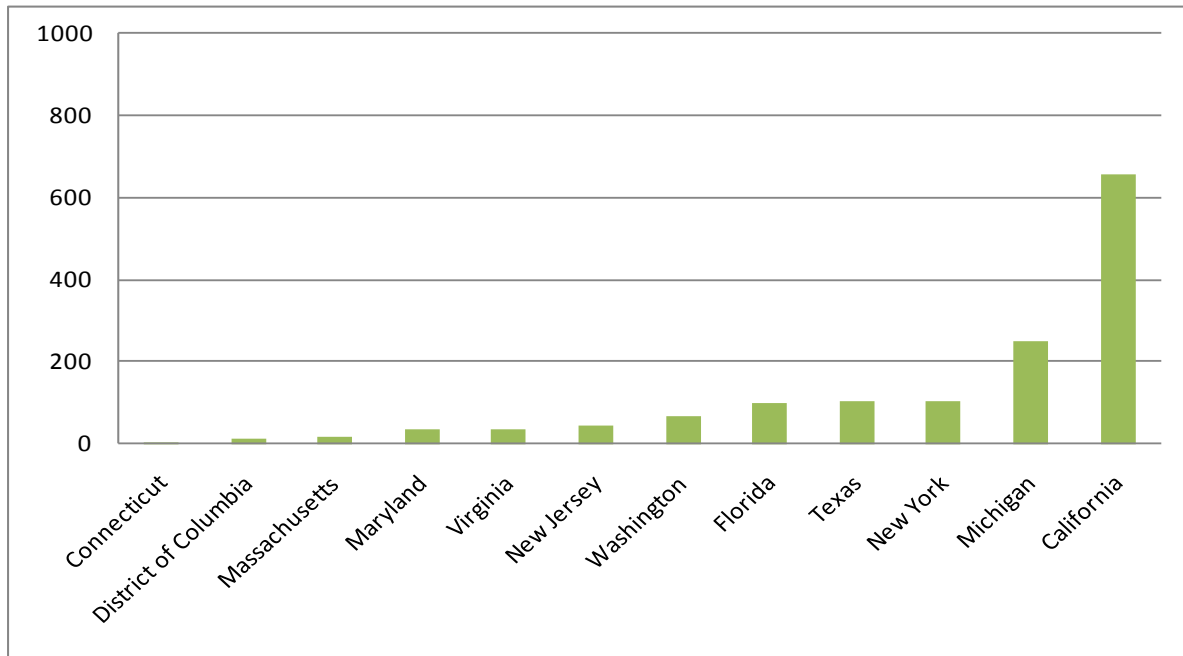
Approximately 300 charging stations are expected in the metropolitan Washington region. Free residential charging stations are available to drivers who own a Chevy Volt, Ford Transit Connect, Ford Focus Electric, BMW ActiveE, Nissan LEAF, Fisker Karma, or Smart Fortwo Electric Drive and live within one of the 12 program regions.

As of December 2011, ChargePoint America had installed 1,432 charging stations across its 12 project areas. Figure 3-10 shows the distribution of charging units across the participating states and the District of Columbia. The District of Columbia received 14 stations, and Maryland and Virginia each received 37, for a total of 88 stations. Among total installations, 694 chargers are residential, 110 are private commercial, 624 are public, and four are not specified. The number of installed ChargePoint America stations in each program region is roughly proportional to its population. The District of Columbia, Maryland, and Virginia have a combined average of just

over six ChargePoint America charging stations per million residents. This distribution is similar to that of New York, New Jersey, and Florida.

**Figure 3-10**

**ChargePoint America Electric Vehicle Chargers Installed by State, May-December 2011**



Source: U.S. Department of Energy Vehicle Technology Program, <http://avt.inl.gov/pdf/evse/CoulombMay11-Dec11.pdf>

### **Maryland Electric Vehicle Infrastructure Program (EVIP)**

This project was made possible by a \$1,000,000 stimulus award to the Maryland Energy Administration (MEA). The program made awards in two categories: electric recharging infrastructure and truck stop electrification (TSE). For electric recharging, MEA committed to issuing grants to entities interested in building electric charging station infrastructure in Maryland. Approximately 81 EV charging stations are currently installed statewide (12 are located in the metropolitan



Washington region). The main areas of EVIP charger deployment include BWI Airport, downtown Baltimore, and Annapolis. Grants for TSE were issued for equipment and installation costs. Partnering with EVIP was the Baltimore Electric Vehicle Initiative (BEVI), which also worked with the Tower Companies to install charging stations in the Maryland suburbs of the metropolitan Washington region.

## **NYSERDA's Northeast Regional Electric Vehicle Network Project**

This project is in partnership with the New York State Energy Research and Development Authority (NYSERDA), the National Association of State Energy Offices, the Georgetown Climate Center, the Transportation and Climate Initiative (TCI), and 16 Clean Cities Coalitions in the Northeast and Mid-Atlantic regions. The project



aims to develop a plan and guidance material to accelerate the introduction of an EV charging station network throughout the Northeast and Mid-Atlantic regions. The Greater Washington Region Clean Cities Coalition is a subgrantee on this project. COG's regional EV planning effort is also focused on assisting this larger effort in the Eastern United States. The TCI initiative is seeking EV pledges (see the following link for more information:

[http://www.georgetownclimate.org/sites/default/files/TCI\\_EV\\_Pledge.pdf](http://www.georgetownclimate.org/sites/default/files/TCI_EV_Pledge.pdf)).

### **Other Regional Projects**

In addition to these federal initiatives, private efforts are underway in Northern Virginia for additional stations at Arlington Potomac Regional Park, at the Virginia Center for Innovative Technology, in Fairfax County, and at Loudoun County Park & Ride lots.

Some COG member jurisdictions are taking actions to support EV deployment. Fairfax County, Virginia, submitted a proposal to DOE to use a portion of their Energy Efficiency and Conservation Block Grant funding for the purchase and installation of 10 Level 2 EV charging stations at county facilities. The county is also focusing on putting EV charging stations in the Tyson's Corner area; plans include guidance on anticipated needs for the future and on site design elements. Fairfax County is looking for direction from the EV Coalition to establish some model practices across the region.

The District of Columbia's Climate Action Plan<sup>30</sup> provides for a substantial incorporation of EVs into the government fleet. The District of Columbia Water and Sewer Authority plans to replace 79 utility vehicles with EVs. The Climate Action Plan aspires to convert 65 percent of the District of Columbia's utility vehicles to EVs by 2012; 200 replacements by 2020; and 350 replacements by 2050. The Action Plan also calls for the expansion of public and private infrastructure to support EV charging stations around the city.

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<sup>30</sup> Government of the District of Columbia. *Climate of Opportunity: A Climate Action Plan for the District of Columbia* [draft for public discussion]. September 2010. Available at [http://rrc.dc.gov/green/lib/green/pdfs/ClimateOfOpportunity\\_web.pdf](http://rrc.dc.gov/green/lib/green/pdfs/ClimateOfOpportunity_web.pdf) <http://sustainable.dc.gov/node/135652>

## PUBLICLY ACCESSIBLE EV CHARGING STATIONS

### Region Charging Station Inventory

COG staff developed an inventory of EV charging stations for the metropolitan Washington region (see Appendix G). As can be seen in Maps 3-1 and 3-2, a robust network of charging stations is beginning to take shape in the region. Altogether, the inventory identified 332 chargers in 133 charging station locations, 11 of which are planned stations. The District of Columbia has the most charging stations among COG jurisdictions (36), followed by Arlington County, Virginia (15); Fairfax County, Virginia (18); and Charles County, Maryland (11). The District of Columbia and Arlington County, Virginia, have the highest number of chargers (85 and 62, respectively). About 40 percent of the chargers are Level 1, and the remaining 60 percent are Level 2. No DC fast chargers were installed when the inventory was developed. The inventory indicates that building managers are installing EVSE in a variety of land uses. Table 3-3 lists the number of charging stations and chargers in the region by site type.

**Table 3-3**  
**EVSE Stations in the Metropolitan Washington Region by Location Type**

Location Type	Stations	Chargers
Office	45	110
Shopping	20	48
Dealership	17	20
Government	11	27
University	10	25
Mixed use	10	38
Multifamily dwelling unit	7	11
Recreation	5	26
Hotel	3	6
Transportation hub	2	4
Airport	2	16
Restaurant	1	1
<b>Total</b>	<b>133</b>	<b>332</b>

*Note:* Recreation includes parks, arts centers, and recreation centers. Mixed use describes sites that have a mix of retail, offices, and housing. Multifamily dwelling units consist of condominiums or apartments. Government stations were located at facilities such as libraries, town halls, and government offices.

Home charging stations are not represented in the inventory, except for multifamily dwelling units.<sup>31</sup>

### **Regional EVSE Infrastructure Maps**

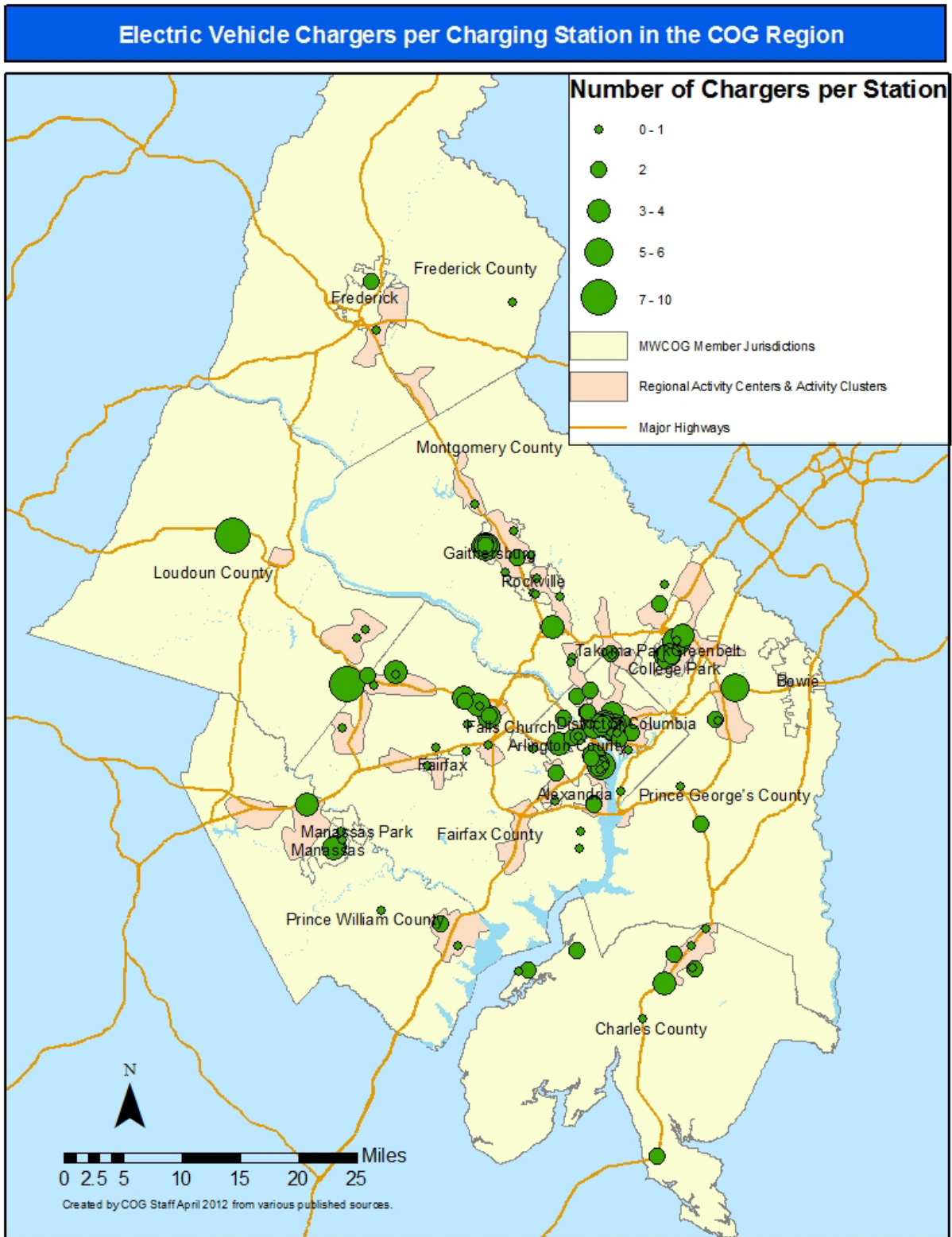
Map 3-1 depicts the published charging station location of existing and planned public and private stations.<sup>32</sup> Since charging stations may have more than one charger present, the size of the symbol on Map 3-2 indicates the number of actual chargers at each location. The maps also depict the location of “Regional Activity Clusters,” as defined by *Region Forward*, and major highways. Most stations are located along major highways or in activity clusters. Sources for the inventory included DOE’s Alternative Fuels Data Center, a COG survey of local jurisdictions, and several EVSE websites, including ChargePoint America, SemaCharge, 350Green, Blink, and Car Charging, Inc. In addition, Plugshare, Google Maps, Clean Technica, and property websites assisted in identifying charging station location information. Some property managers provided additional information.

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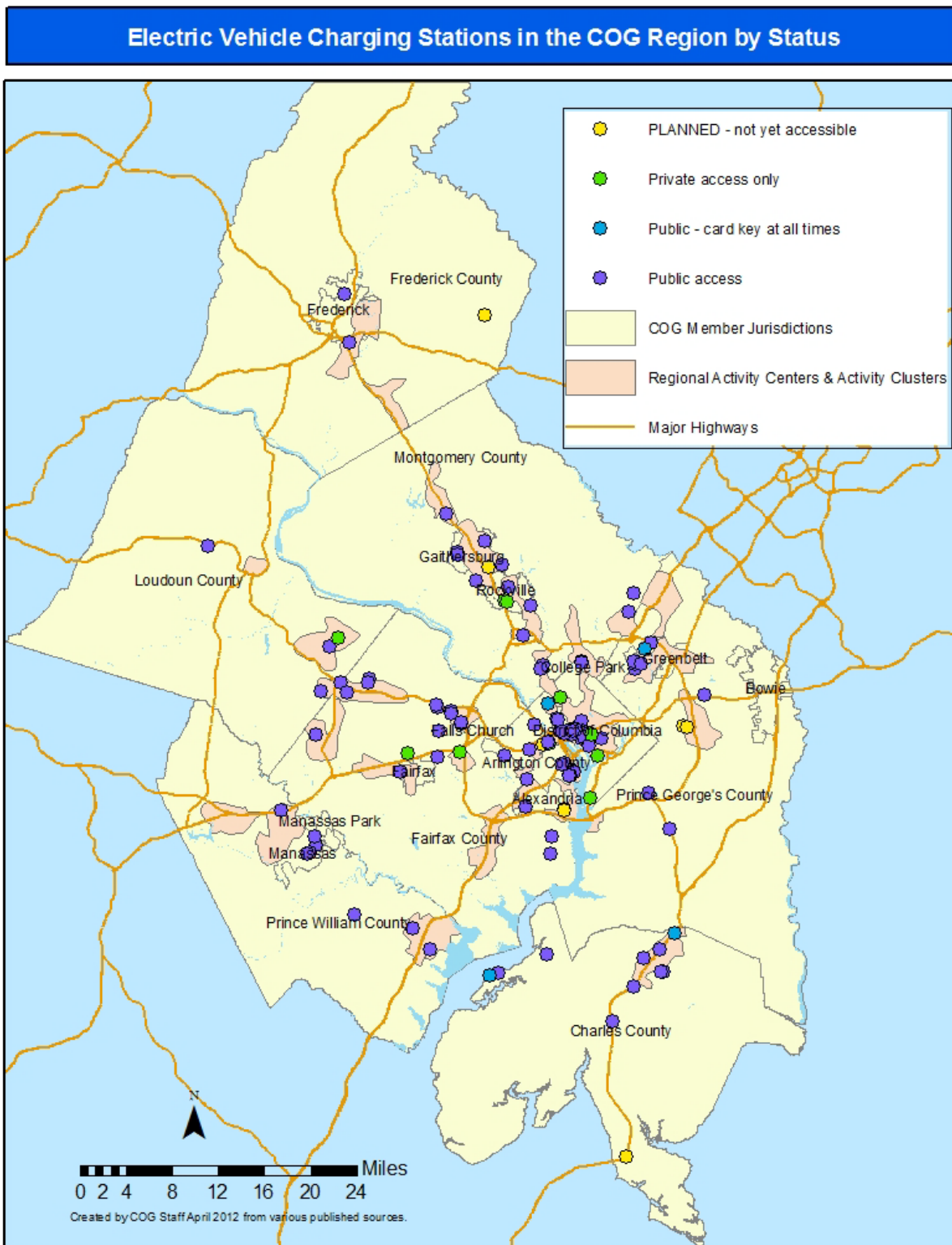
<sup>31</sup> Although many EV infrastructure development programs in the region involve installation of home charging stations, published data on these stations are incomplete for several reasons: (1) stations are not published on EVSE provider websites or on the Alternative Fuels Data Center since they are not available for public use; (2) many individuals choose not to voluntarily share their location information with Plugshare, a crowd-source EV station website; and (3) EV owners aren’t required to report their home charging stations to electric utilities. Other regions that The EV Project is operating in report that 80 percent to 99 percent of Level 2 charging stations are installed at home locations.

<sup>32</sup> Maps do not include single-family home stations.

Map 3-1



Map 3-2



## **EV and EVSE DEPLOYMENT PLANNING RECOMMENDATIONS**

Facilitating charging station installation through investments, incentives, guidelines, and requirements can reduce range anxiety, promote innovation and environmental sustainability, and help overcome market barriers to region-wide deployment. The main barriers for all location types are cost of installation, access to power source, parking space turnover management, need for streamlined permitting and inspections, and lack of information and training resources.

### **Recommendation 1: Local governments should promote EVSE siting in strategic locations and monitor EV use and EVSE installations.**

- a. Identify key charging locations near workplaces, shopping destinations, and transit hubs to prioritize for EVSE installation. The following are some feasible locations:
  - workplace locations with parking such as office parks;
  - surface parking lots or curbside locations;
  - hotels and convention centers;
  - hospitals;
  - transportation hubs such as airports, fleet depots, and Park & Ride facilities;
  - gas stations;
  - shopping malls and other retail locations;
  - entertainment destinations such as cultural centers, restaurants, sporting venues, and parks and recreation areas;
  - universities; and
  - government buildings such as city halls and libraries.
- b. Promote additional opportunities for EV charging among car-sharing programs and rental companies.
- c. Benchmark EV sales and use and EVSE installation and use in the metropolitan Washington region and compare these benchmarks with data from other cities to identify additional needs or barriers.
- d. Establish network interconnectivity among all publicly accessible charging stations in the metropolitan Washington area, such as through a third-party universal membership.

### **Recommendation 2: Local governments, in cooperation with businesses, OEMs, and utilities, should equip major new construction and redevelopment in the commercial, multifamily, and public sectors with a feasible level of inexpensive technology to reduce the cost of future EVSE installation.**

- a. Provide the physical space for transformer capacity to allow the future installation of full-lot electrification.
- b. Provide physical space in the electrical room to allow future installation of a switchboard and capacity for submetering.



- c. In parking area construction, include conduit bank and conduit between the facility's electrical room and the spaces needed for future electrification.
- d. Install a conduit for future on-street EV parking during right-of-way redevelopment.

**Recommendation 3: Governments, businesses, and stakeholders should work together to address multifamily residential EV charging challenges.**

- a. Follow best practices and heed lessons learned in pilot programs from other U.S. cities.
- b. Connect property owners and managers, homeowners associations, and condominium associations with educational resources relating to EVSE implementation.
- c. Pursue car-sharing and charger-sharing agreements to help meet multifamily building charging needs.

**Recommendation 4: Governments and stakeholders should facilitate workplace charging by identifying prime charging locations, connecting employers and property managers with EVSE installation resources, and building partnerships between businesses and EV industry players.**

- a. Identify prime workplace charging locations on the basis of commuting patterns, survey of fleet needs, and EV charger installation plans.
- b. Through COG Commuter Connections, the Apartment and Office Building Association, and other associations, connect employers and property managers with EVSE installation procedures and resources.
- c. Develop partnerships between corporate offices and EV dealerships/service providers to deploy fleet EVs and charging stations.
- d. Develop informational brochures to identify risks and benefits to employers of providing workplace charging as well as installation procedures and resources. These brochures can identify methods to mitigate or reduce risk and increase employee acceptance.

**Recommendation 5: Businesses and OEMs should develop tourist market opportunities by increasing the availability of EV rentals and developing charging infrastructure at hotels and tourist destinations.**

- a. Work with rental car companies, hotels, and public on-street parking locations close to tourist destinations to set up a minirental infrastructure.

**Recommendation 6: Governments, OEMs, businesses, and other stakeholders should consider offering incentives to promote investment in publicly accessible EV infrastructure.**

- a. Offer a variety of incentives, such as tax credits, access to HOV lanes, fast-tracking permitting processes, and/or free parking benefits to consumers who purchase and drive an EV.

- b. Offer incentives, such as tax credits, for hosts who install EVSE at their destination location. Provide official recognition emblems and advertising icons as “EV Friendly Business” for hosts to use in stores and advertising.
- c. Offer benefits to developers who invest in EVSE infrastructure.

## SECTION 4

### LOCAL GOVERNMENT POLICY

Local governments will play a critical role in the region's electric vehicle (EV) readiness. To facilitate continued growth of the market and smooth the transition to higher rates of EV adoption, local governments should ensure that EV infrastructure development is addressed in comprehensive planning efforts and that zoning, building codes, and permitting and inspection processes provide a pathway to the expeditious installation of charging equipment.<sup>33</sup>

Streamlined permitting and inspection processes, vehicle and charging incentives, infrastructure readiness, low permitting and inspection costs, and nominal installation costs all contribute to a more EV-friendly policy environment.

In January 2012, COG conducted a survey of its member jurisdictions to obtain information about current initiatives in the region. (Appendix H contains the survey questions and results.) The purpose of the survey was to determine the current level of EV-related activity and development among jurisdictions in the region. Using information from that survey, this section addresses the current state of EV planning initiatives in COG's member jurisdictions. (See Appendix I for more detail on applicable EV incentives, laws, and regulations that are now in place in the region.) This section also discusses best practices gleaned from EV programs across the nation on developing model codes, on ensuring ADA accessibility at charging stations, and on developing requirements for parking spaces that can accommodate use by EV chargers. Facilitating permitting and inspections for EV infrastructure is also key to the region's EV readiness. Next, this section discusses survey results on current permitting and inspection practices in the region, followed by a discussion of best practices related to permitting, inspections, and electrical codes.

The recommendations related to comprehensive planning, zoning, and building codes include developing a guide for comprehensive planning that promotes EV infrastructure development; amending zoning ordinances to promote EV deployment, and establishing design criteria to address ADA accessibility, safety, and theft deterrence. Inspections and permitting recommendations focus on streamlining the permitting process for EVSE installation, developing a consistent set of EV permitting procedures, and amending electrical permit applications to include information on EV charging.

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<sup>33</sup> Not all jurisdictions have the authority to initiate and implement these policies.

## **COMPREHENSIVE PLANNING, ZONING, AND BUILDING CODES**

### **Regulatory Readiness for EV Deployment**

Regulatory readiness for EVs is built on good comprehensive planning, building codes, and zoning done at the local level. A comprehensive plan is a general policy guide for growth and development for a local government. It acts as a long-range guide, intended to show the future use of land at some point during the planning period, which could project as far ahead as 20 years or more.

A local government's comprehensive plan can elevate the importance of EV infrastructure planning across multiple departments, highlighting the need for coordination among land use, capital facilities, utilities, and transportation planning efforts. The plan should provide guidance on where EV charging stations should be allowed, where they should be actively promoted, and where they should be discouraged or prohibited. In addition, a comprehensive plan should provide context for negotiating with developers on EV charging station commitments.

Whereas a comprehensive plan provides guidance on where EV charging stations should be promoted and discouraged, zoning ordinances dictate where charging stations are allowed or prohibited.<sup>34</sup> Zoning ordinances can also define priority areas where EVs may receive incentives, such as preferred parking. Coordination of comprehensive planning and zoning work ensures effective and consistent zoning decisions at the local level. Because comprehensive plans are policy and not regulatory documents, regulatory changes (e.g., zoning ordinance provisions) and legally binding commitments or conditions associated with local government zoning decisions will be necessary if plan policies are to be implemented.

Municipal and county codes are an additional component of the EV planning framework. They define specific guidelines by which developers must abide to ensure the safety, accessibility, and standardization of EV charging installments, parking, and signage. Design standards to address American with Disabilities Act (ADA) accessibility are needed to ensure that EV charging stations can serve all customers. As well, guidance on reducing tripping hazards, electrical hazards, and vandalism or theft of EV charging stations will increase the safety of EV infrastructure for the public. Consistent signage for EV charging spaces may also be defined in municipal codes, ensuring that EV charging stations are not only accessible and safe, but also easily identified.

### **COG Region Initiatives**

Most of the COG jurisdictions reported having no EV policy development in place. Policies could include comprehensive plan language for new or redevelopment projects or zoning/land

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<sup>34</sup> Zoning ordinances set specific standards for use, density/intensity, size, setbacks, height, and open space.

use language for existing development. The District of Columbia and Fairfax County, Virginia, have integrated EV zoning considerations into the permit review process, building code policy, and ADA parking restrictions.

Although the COG survey of local governments' EV practices revealed that most member jurisdictions currently have little to no EV-related activity or development, the regional EV planning effort has motivated involvement. While it is expected that individual member jurisdictions will plan for and implement EV-related policies at their own pace, the metropolitan Washington region is ripe for EVs and charging deployment. With this region as a target market for deployment by top manufacturers of EVs, jurisdictions like Montgomery County, Maryland, and Arlington County, Virginia, have begun examining their processes and looking at creative ways to integrate EV planning in their already robust climate and sustainability strategies.

Fairfax County, Virginia, has examined how EV planning may be introduced into the comprehensive planning process and has begun formulating potential language to integrate into the plan. If EV-related plan text is adopted into the county's comprehensive plan, it would provide a context for the negotiation of EV-related commitments from applicants during the zoning process.<sup>35</sup> Appendix J includes examples of language that could be applied by localities within comprehensive plan policies.

The District of Columbia; the City of Frederick, Maryland; the City of Bowie, Maryland; Fairfax County, Virginia; and the City of Manassas, Virginia, currently offer incentives for EVs. The incentives offered include dedicated on-street public charging near building entrances, preferred parking in public parking decks, preferred parking for fuel efficient vehicles at government buildings, and preferred parking at some LEED (Leadership in Energy Design) buildings. The remaining jurisdictions reported that they do not offer any incentives for EVs or did not indicate whether they were offered.

### **Best Practices: Developing Model Codes**

Model codes can help states achieve a consistent EV framework across their local jurisdictions. Model codes should reflect best practices and ease the adoption of codes and processes by preventing local governments from having to “reinvent the wheel.”

The State of Washington provides a great example for states and municipalities to address EVs through model codes and ordinances. In coordination with the Puget Sound Regional Council,

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<sup>35</sup> Kaplan, Noel H., Fairfax County Dept. of Planning and Zoning. *Fairfax County's Comprehensive Plan and Potential Application in Support of Electric Vehicles* [presentation to the COG EV Planning and Processes Work Group]. November 29, 2011. Available at: [https://ncrportal.mwcog.org/sites/surveys/EVP/Comprehensive%20Planning/Comprehensive%20Plan\\_Kaplan%20Ffx%20\(2\).pdf](https://ncrportal.mwcog.org/sites/surveys/EVP/Comprehensive%20Planning/Comprehensive%20Plan_Kaplan%20Ffx%20(2).pdf)

they developed the *Electric Vehicle Infrastructure: A Guide for Local Governments in Washington State*, which provides model installation guidance and checklist, siting and zoning guidance for on-street and off-street, and model ordinance and regulation language for infrastructure and batteries varies parking scenarios including ADA requirements.<sup>36</sup> A sample of model installation guidance for charging and installation checklist is provided in the Washington State Guide Appendices.<sup>37</sup>

### **Best Practices: ADA Compliance**

Title II of the Americans with Disabilities Amendments Act of 2008 (ADA) covers all activities of state and local governments and requires governments to give people with disabilities an equal opportunity to benefit from all of their programs, services, and activities. Accessibility standards specific to EV infrastructure have not been established in most jurisdictions—guidance on developing such standards should be provided to assist to local governments in meeting ADA compliance.

ECOTality's *Lessons Learned—EV Project: Accessibility at Public EV Charging Stations*, prepared for the U.S. Department of Energy, provides an in-depth review of general parking accessibility requirements and barriers to widespread acceptance and adoption of EV charging. The report provides four recommendations that address ADA compliance issues for Level 2 electric vehicle supply equipment (EVSE) and DC fast chargers.<sup>38</sup>

Federal standards generally call for a 1:25 ratio of parking places to be set aside for qualified persons. The State of Washington adopted guidance that the first of any EV charging parking spaces be ADA accessible and that other ADA-accessible spaces be provided at a 1:50 ratio.<sup>39</sup> California's Division of State Architects issued guidance, *Interim Disabled Access Guidance for Electric Vehicle Charging Stations*, requiring a 1:25 ratio of parking places at a site for accessible charging stations.<sup>40</sup> For examples of on-street and off-street accessible EV charging

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<sup>36</sup>State of Washington Department of Commerce & Puget Sound Regional Council. *Electric Vehicle Infrastructure: A Guide for Local Governments in Washington State*. July 2010. Available at <http://www.commerce.wa.gov/DesktopModules/CTEDPublications/CTEDPublicationsView.aspx?tabID=0&ItemID=8851&Mid=863&wversion=Staging>

<sup>37</sup> [http://psrc.org/assets/4326/EVI\\_full\\_appendices.pdf](http://psrc.org/assets/4326/EVI_full_appendices.pdf)

<sup>38</sup> Sustainable Transportation Strategies. *EV Charging for Persons with Disabilities*. February 2012. Available at <https://ncrportal.mwcog.org/sites/surveys/EVP/ADA%20Compliance/ProjGetReady%20-%20EV-Charging-ADA-Version-1.0s.pdf>

<sup>39</sup>State of Washington Department of Commerce & Puget Sound Regional Council. *Electric Vehicle Infrastructure: A Guide for Local Governments in Washington State*. July 2010. Available at <http://www.commerce.wa.gov/DesktopModules/CTEDPublications/CTEDPublicationsView.aspx?tabID=0&ItemID=8851&Mid=863&wversion=Staging>

<sup>40</sup> California Department of General Services. *DSA—2011 California Access Compliance Reference Manual Policies*. Rev. January 1, 2011. Available at [http://www.documents.dgs.ca.gov/dsa/pubs/policies\\_rev\\_01-01-11.pdf](http://www.documents.dgs.ca.gov/dsa/pubs/policies_rev_01-01-11.pdf)

parking design, including ADA requirements, as well as directional signage, see the Washington State guidance.<sup>41</sup>

As state and local governments develop code language for EV infrastructure, it is important for them to keep in mind the following criteria when designing a parking space:

- Minimum parking space width of eight feet for a car and 11 feet for a van.
- Five-foot-wide minimum access aisle. Two accessible parking spaces can share an aisle between them.
- Vertical clearance of at least 98 inches for a van.
- Nearly level (less than 2 percent slope in any direction) and firm ground surface.
- Accessible curb cut if needed to reach and operate the charging station.

### **Best Practices: Parking Requirements for EVSE**

Parking requirements that incorporate EV charging considerations help promote EV infrastructure and provide an incentive for EV drivers. Many localities are beginning to consider and adopt EV parking requirements in their municipal codes.

The city of Vancouver, British Columbia, requires that 20 percent of the parking stalls that are for use by owners or occupiers of dwelling units in a multifamily building include a receptacle to accommodate use by EV charging equipment.<sup>42</sup>

San Francisco is also working with other Bay Area jurisdictions to add provisions to the Green Building Code that require parking spaces in new homes, apartments, condominiums, hotels, and other commercial and municipal buildings constructed in the city or major renovations to be wired to accommodate EV charging. This will avoid expensive retrofit wiring as the number of EV users increases.

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<sup>41</sup> Washington State Department of Commerce, Electric Vehicle Infrastructure, A Guide for Local Governments in Washington State, July 2010, pp.25-31. [http://psrc.org/assets/4325/EVI\\_full\\_report.pdf](http://psrc.org/assets/4325/EVI_full_report.pdf)

<sup>42</sup> City of Vancouver. *Electric Vehicle Infrastructure Requirements for Multi-Family Buildings*. Available at: <http://vancouver.ca/sustainability/EVcharging.htm>

## **PERMITTING AND INSPECTION**

### **Facilitating Permitting and Inspection for EV Readiness**

One of the prerequisites for the growth of EV infrastructure is rapid permitting and inspection. The ease with which a consumer can obtain a permit for EV charging installation can impact how quickly the technology is embraced. Thus, local governments' streamlining of the inspection and permitting process for EV charging would facilitate market expansion of EVs.

Developing rapid permitting processes is an essential first step to facilitating EV infrastructure expansion. Providing online applications would ease the administrative burden for relatively simple installations and those conducted by certified contractors. Local governments should also be attentive to permit turnaround times. Permits for residential charging stations should be issued in no more than two business days, and same-day turnaround is preferred. Public charging stations may require longer inspection times, however, due to potential construction considerations.

To help residents and contractors successfully and safely navigate the permitting and inspection process, local governments should develop consistent permitting and inspection procedures for Level 1, Level 2, and DC fast charge installations. Written guidance and installation checklists for contractors and government installers should also be provided. Attention to the Level 2 and DC fast charge permitting and inspection process is particularly important because these options offer faster and higher charging rates that could cause surges in demand. A one-time fee for each of these charging scenarios that includes both permitting and inspection costs would further ease the process.

Charging station hardware is not required for Level 1 charging because it uses a standard electric outlet, but the installation of a dedicated circuit and other safety precautions may be needed if the existing wiring and/or panel is inadequate. Streamlined processes for simple residential installations such as these may be appropriate. In contrast, Level 2 and DC fast charging installations require special charging equipment with a dedicated higher-voltage circuit. For DC fast charging, electric utility infrastructure may also need to be installed.

Multiunit residential buildings require special attention to ensure charging availability and access for residents. Updating and enhancing building codes to encourage retrofits of multiunit buildings would help remove this barrier.

Finally, the permitting process can also help utilities plan for EV adoption and make necessary upgrades to transformers and other electric utility infrastructure. By tracking the location, voltage, and amperage of new EVSE installations, municipalities can help utilities prepare the electrical grid for the widespread adoption of EVs. In Section 5 on Electric Utility Policy,



recommendations are made that specify how permits should be managed to best provide needed information to utility companies.

### **COG Region Initiatives**

The January 2012 COG survey on EV initiatives in the region provided an overview of the current status of the permitting and inspection processes in the region. The survey questions and responses are presented in Appendix H. Highlights are presented below.

Turnaround times for obtaining electrical permits and inspection varies, with Fairfax County, Virginia, reporting the lowest turnaround time for commercial and residential permits, and the District of Columbia reporting the fastest turnaround time for public permitting. Falls Church, Virginia, reported the slowest turnaround times for all types of permits.

The cost for permitting EVSE varies throughout the region. Falls Church, Virginia, reported the least expensive permitting costs of \$10 for residential, commercial, and public electrical permits, and Fairfax County, Virginia, reported the highest electrical permitting fee of \$85 for both residential and commercial electrical permits. Most reporting jurisdictions indicated that they offer online permit applications.

Of those jurisdictions responding, only the City of Frederick, Maryland, and the City of Falls Church, Virginia, indicated that they are tracking EV charging permit applications. It is important to note that most jurisdictions consider EV charging infrastructure to be a standard electric appliance for Level 1 (120V, 15 amps, single phase) or Level 2 (208/240V, 30 amps, single phase) charging.

### **Best Practices: Clear Permitting Guidelines**

To make the EVSE permitting process more streamlined and user friendly, municipalities should make sure that guidelines are clear and understandable to residents and businesses. The metropolitan Washington region can look to the experiences of Raleigh, North Carolina; Houston, Texas; and the State of Massachusetts for best practices on communicating clearly about the EVSE permitting process.

Raleigh, North Carolina, has developed a chart detailing a step-by-step process for residents that outlines the information required and the steps necessary for the installation of EV charging

equipment in a single family home.<sup>43</sup> The City of Raleigh has also developed two YouTube videos on how to install public<sup>44</sup> and home charging equipment.<sup>45</sup>

Houston, Texas, has implemented an EV permitting and inspection process for a standard EVSE project that can be completed in one day. The City's Green Transportation Initiative includes an EV program that has developed a six-step installation process that includes identification, assessment, permitting, installation, inspection, and integration. Permits are issued automatically and instantly online through the City's Code Enforcement Group,<sup>46</sup> with inspections being performed on the same day as the installation.

The Massachusetts State Department of the Environment developed an installation guide for EV charging, *Installation Guide for Electric Vehicle Supply Equipment*.<sup>47</sup> The Guide includes an installation diagram and flow chart for residential charging. The Guide also specifically references NEC 625.1-625.5, the relevant National Electrical Code charging standards.

### **Best Practices: Online Permit Processing**

Allowing permits to be processed online, rather than through the mail or in person, can speed the process. Charlotte, North Carolina; the State of Oregon; and San Francisco, California, offer examples of methods for expediting permit processing.

In Charlotte, North Carolina, the Mecklenburg County Code Enforcement and the Building-Development Commission introduced two "self-permitting" options, the Homeowner Internet Permits (HIPs) and Trades Internet Permits (TIPs). HIPs are required for homeowners making renovations on their own property, while TIPs are required for contractors. One of these permits must be secured for an EV charging station to be installed. The TIP manages 25 percent of the permit load, with a goal of a TIP-like tool managing all projects not requiring plan review. Mecklenburg County's EV Initiative uses the TIP process for EV charging permit applications, reducing the permit turnaround time to 1–2 days.

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<sup>43</sup> City of Raleigh. *Electric Vehicle Charging Station Installation*. Available at <http://www.raleighnc.gov/search/content/CityMgrDevServices/Articles/HowToElectricVehicleCharging.html>

<sup>44</sup> City of Raleigh. *Installing Public Charging Stations* [YouTube video]. November 30, 2010. Available at <http://www.youtube.com/watch?v=ivPLvsg9y2o>

<sup>45</sup> City of Raleigh. *How-To Charge Your Electric Car at Home* [YouTube video]. September 27, 2010. Available at <http://www.youtube.com/watch?v=x4YezUX8lo&lr=1&uid=makWAtClzgsRXZUNcZyNEA>

<sup>46</sup> <http://www.houstonpermittingcenter.org/code-enforcement.html>

<sup>47</sup> <http://www.mass.gov/eea/docs/doer/alternative-fuels/ev-manual-mass-32011.pdf>

In Oregon, the Electrical Specialty Code contains the minor label program,<sup>48</sup> which allows certified contractors participating in the program to install eligible equipment without having every installation inspected, as with the traditional permitting process. Minor labels are inexpensive permits for minor electrical and plumbing installations in either residential or commercial settings. Contractors establish an online account, buy the labels online, perform the installations, and document how the labels were used through their account. The Oregon Building Codes Division randomly selects for inspection one installation from every 10 labels a contractor uses.

The City of San Francisco's Department of Building Inspection issues same-day, over the counter permits for the necessary electrical work at a residence, and electricians registered with the Department of Building Inspection can obtain the permits instantly online.

### **Best Practices: Electrical Codes**

The National Electrical Code (NEC), produced by the National Fire Protection Association, provides safety guidelines for electrical equipment installation. Local governments should adopt these guidelines, so they can require the highest safety standards for EV charging infrastructure.

Table 4-1 contains a sample of relevant NEC sections. For a full list of applicable codes and standards, refer to the Advanced Energy's *Charging Installation Handbook for Contractors and Inspectors*.<sup>49</sup>

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<sup>48</sup> State of Oregon, Building Codes Division. Minor Label Program. Available at

[http://www.bcd.oregon.gov/programs/minorlabel/minor\\_label\\_programs.html#2](http://www.bcd.oregon.gov/programs/minorlabel/minor_label_programs.html#2)

<sup>49</sup> <http://www.advancedenergy.org/transportation/evse/Charging%20Handbook.pdf>

**Table 4-1**  
**National Electrical Code (NEC) Relevant to EVSE**

Standard	Description
NEC 110.28	- Enclosure Types
NEC 110.26	- Electrical Equipment Spacing
NEC 110.26 (A)(2)	- Width of Working Space
NEC 110.27(B)	- Guarding of Live Parts – Prevent Physical Damage
NEC 210.70(A)(2)	- Lighting Outlets Required – Dwelling Units – Additional Locations
NEC 625.1-625.5	- General (Scope, Definitions, Other Articles, Voltage, Listed/Labeled)
	- EVSE Locations
NEC 626.28-625.30	- Standard for flexible cords and cables required by NEC 625
UL	- Cord design and safety covers the plug, cord, receptacle, connectors and
UL 2251	other items related to the charging cord set. Also verifies the cord’s safety and ability to carry its rated load.

Source: Advanced Energy, <http://www.advancedenergy.org/transportation/evse/Charging%20Handbook.pdf>

## **COMPREHENSIVE PLANNING, ZONING, AND BUILDING CODES RECOMMENDATIONS**

Below are recommended changes to comprehensive plans, zoning, and building codes that would facilitate the installation and operation of EV charging stations.

### **Recommendation 1: Local governments should develop comprehensive plan guidance to guide EV infrastructure development.**

- a. Include in comprehensive plans identification of key areas for EVSE deployment and context for negotiating with developers on EV charging station installation commitments during the development approval process.

### **Recommendation 2: Local governments should amend zoning ordinance to support EV deployment.**

- a. Amend all zones except conservation areas to allow for EV charging as an accessory, conditional, or principal use.
- b. Allow EV battery exchanges at gas stations within one mile of highways.

### **Recommendation 3: Local governments should establish design criteria to address ADA accessibility, safety, and theft deterrence.**

- a. For public and commercial charging stations, establish design standards to address ADA accessibility, space dimensions, tripping hazards, electrical hazards, and theft deterrence, including cost information (ADA compliance may be met by requiring attendant assistance).
- b. Follow examples such as the *Advanced Energy Charging Installation Handbook*.

### **Recommendation 4: Local governments should establish guidelines for integrating EV infrastructure with public streets and publicly accessible spaces.**

- a. Work with communities, neighborhoods and business improvement districts to develop EV infrastructure design plans that blend in with the surrounding area.
- b. Establish guidelines addressing preferred locations for EVSE installations on public streets—at either end of a row of spaces or near a power source—and working around trees and other infrastructure.
- c. Synchronize charging time limits with current street parking time limits at each location if possible.
- d. Allow charging station owners/managers the ability to control turnover, such as by raising the rate after two hours.
- e. Follow the *Advanced Energy Charging Installation Handbook*.

**Recommendation 5: Local governments, in collaboration with state and federal government, should standardize signage for EV charging stations.**

- a. Include in signage standards specifications for signage height, bollards, and lighting.
- b. Include in signage standards requirement that signage notify users of security measures such as cameras and other deterrence devices and include instructions for dealing with nonretracting cords.
- c. Include in signage standards requirement that signage contain information about the hourly and/or total cost of the charging service, if applicable.
- d. Base standards on the Federal Housing Administration's *Manual for Uniform Traffic Control Devices*.
- e. Use green paint to delineate EV charging spaces.

**INSPECTIONS and PERMITTING RECOMMENDATIONS**

**The recommendations below focus on ways that local governments and utilities can streamline the permitting and inspections process for EVSE installations.**

**Recommendation 1: Local governments should streamline the permitting and inspection process for EVSE installations.**

- a. Develop streamlined inspection process with a two to three business day turnaround time for public, nonconstruction, and private (residential) charging installations.
- b. Develop a streamlined process, waiving certain requirements (such as producing plans and drawings) for simple residential installations.
- c. Update and enhance building codes and fast-track approval to encourage multiunit dwellings retrofitting.

**Recommendation 2: Local procedures for each EV charging scenario.**

- a. Develop a consistent set of permitting and inspection procedures and checklists for entities seeking permitting on the basis of three main EV charging scenarios:
  - Level 1 (120V, 15 amps, single phase): Residential and commercial charging (same process as with any other 120-volt outlet installations in residential and commercial facilities)
  - Level 2 (208/240V, 40 amps, single phase): Residential and commercial charging
  - Level 3/DC fast charge (480V, 90 amps, 3-phase): Commercial, parking garages and lots charging
- b. Institute a one-time fee for each of the three main EV charging installation scenarios that combines all applicable fees for both the permit and inspection process.

- c. Develop guidance and checklists for each of the charging scenarios to educate EVSE installers, homeowners, and businesses, and relevant government employees about the procedures involved in EVSE permitting and inspection.

**Recommendation 3: Local governments, in cooperation with utilities, should amend electrical permit applications to include a field noting whether the facility will include EV charging.**

- a. Include on the permit application a field noting the voltage and amperage of the EVSE installation.
- b. Provide location and all relevant EV charging information to the local electric utility to assist with grid planning efforts.

## SECTION 5

### ELECTRIC UTILITY POLICY

Increasing electric vehicle (EV) adoption poses two distinct electric utility policy issues. The first is notification of EV charging locations. Utilities are concerned that neighborhood “clustering” of EV charging could cause disruptions in the local power grid. Utilities need to be notified in advance about the location of EV charging equipment so they can ensure that appropriate infrastructure is in place to accommodate the increased load and avoid service disruptions for their customers. For DC fast charge stations, further advance notice is needed. Strategies to inform utilities about where EVs are being charged are critical to the infrastructure planning process.

Second, the regulatory status of EV charging stations—contained in provisions of electric utility policy—can help or hinder the ability of private companies and utilities to provide EV charging services. Across the region, the regulatory status of EV charging service providers is inconsistent and in some cases unclear. Clear state-level policies are needed to promote private investment in EV charging infrastructure for charging in the for-pay charging market. Other issues impact utilities and utility policy: renewable and clean energy goals that reduce the estimated indirect emissions impact of EV use, the use of smart-grid-ready electric vehicle supply equipment (EVSE), regulations concerning second meters for EV charging, and the development and promotion of education and pilot programs.

This section begins with an analysis of the impacts that growing EV use could have on the electrical grid—depending on the size and timing of the increased charging load, on the extent of clustering of EV use, and on the type of charging used. Next, recent policy actions in the region are presented, followed by a discussion of the regulatory status of key policy issues and relevant program offerings in Maryland, Virginia, and the District of Columbia. Then an analysis of issues that will be of concern in the future is presented, and finally, the policy recommendations that emerged from this analysis are listed. The recommended policies include promoting exemption from regulation of EVSE service providers from electric utility regulation, notifying utilities of EVSE installations, and reducing upstream emissions from EV charging.

#### **ELECTRIC GRID IMPACTS**

With significant penetration of EVs still years away, EV charging load is not anticipated to have significant effects on generation and transmission infrastructure. Neighborhood-level clustering of EV charging, however, is a current concern for electric utilities, and infrastructure planning must be undertaken to prevent service disruption.



## **Generation and Transmission Infrastructure Impacts**

The potential for EV charging to impact the electrical grid at the generation and transmission level depends highly on the size of the charging load and its timing relative to daily and seasonal electricity demand. On the one hand, adding large amounts of EV charging load to the grid at times of already high demand can amplify peak load and stress the electrical grid. As EV adoption increases significantly, unmanaged EV charging, particularly in the afternoon hours on the hottest summer days, could cause congestion that leads to brownouts or blackouts. However, increasingly stringent appliance efficiency standards and building codes will significantly reduce the likelihood of this occurring.

On the other hand, if EV charging is conducted at off-peak times, such as overnight, it could have the beneficial effect of evening out the load curve, called *valley filling*. This allows generating facilities to run more consistently, thereby providing more efficient and less costly electrical power.

While generation and transmission infrastructure impacts are not a significant current concern for utilities, this issue must be monitored to prevent future negative grid impacts. Other federal, state, and local policies related to appliance energy efficiency standards and building efficiency codes will help counter the effect of increasing EV loads. The EV Project, a partnership between the U.S. Department of Energy, ECOtality North America, and a number of corporate, nonprofit, and local government stakeholders, is helping fulfill this role in Washington, DC, and a number of states across the country.

## **Distribution Infrastructure Impacts**

The immediate concern that most utilities have about the impact of EV charging is the clustering of vehicles at the distribution level. Preliminary data from auto manufacturers and state motor vehicle agencies demonstrate that EV adoption has not been evenly dispersed across a large area, but rather clustered in residential pockets. These clusters can significantly increase local electricity demand, overloading transformers and increasing the risk of local service disruptions. An EV's power demand is a function of the type of charging used. Level 1 charging, using a 120V AC charger, is not likely to significantly impact the distribution grid. However, multiple EVs charging at Level 2 (240V AC) have the potential to overload residential transformers. Planning for distribution grid upgrades is essential to mitigating this risk, and information about the locations of EV charging stations will aid this effort.

## **DC Fast Charging Impacts**

DC fast charging requires special attention from utilities. DC fast charging is not being used for residential EV charging because of its high voltage and amperage levels, but interest in the technology for public charging stations is growing. This type of charging equipment requires

higher voltage, larger cables, and larger conduit, and thus has greater potential than Level 2 charging for impacting utility infrastructure. Thus, it is essential that utilities are informed of specific deployment plans for DC fast charging infrastructure so that the appropriate equipment may be installed and nearby customers will not be impacted.

## **RECENT STATE POLICY ACTIONS**

Maryland, Virginia, and the District of Columbia have all taken steps in recent years to resolve areas of uncertainty in their electric utility policy as it relates to EVs and EV charging.

However, room for improvement remains, particularly when it comes to notifying utilities about EV charging station locations. (Appendix K contains information on related best practices in California.)

In accordance with legislation passed in the 2011 session of the Maryland General Assembly, Governor Martin O'Malley commissioned an Electric Vehicle Infrastructure Council, comprised of representatives of automobile manufacturers, EV charging manufacturers, utilities, electrical workers, state and local governments, and environment and energy experts. The Council is in the process of developing recommendations on infrastructure planning, policy changes to support EV charging, standards for streamlined permitting, and consumer outreach and awareness efforts. The Council issued an Interim Report in January 2012.<sup>50</sup> The report contains several policy recommendations that are relevant to utility policy and EV charging.

In 2010, Virginia Clean Cities released an initial EV plan titled Virginia Get Ready. The plan resulted from the work of over 100 stakeholders, including governments, universities, public utilities, civic entities, and businesses. It presents an analysis of the then-current state of the EV market and offers recommendations in a number of areas. Then, in 2011, the Virginia legislature passed several bills that helped define the status of EV charging station owners and operators in the state.<sup>51</sup> In addition, the Virginia State Corporation Commission (SCC) approved Dominion Virginia Power's EV charging pilot program in July 2011. The program became effective in October 2011.

The District of Columbia does not have a well-defined EV charging policy. The Public Service Commission (PSC) first implemented pilot EV rates in 1993 but discontinued them in 2006 due to low participation. The PSC currently has a case open to consider a broad range of EV policy questions, including EV chargers' regulatory status and whether special EV charging rates

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<sup>50</sup> Electric Vehicle Infrastructure Council. *Interim Report*. January 1, 2012.

<http://www.msa.md.gov/megafile/msa/speccol/sc5300/sc5339/000113/014000/014354/unrestricted/20120165e.pdf>

<sup>51</sup> Virginia General Assembly. Public Utilities—Electric Vehicle Charging Service; Excludes Certain Persons from Retail Sale of Electricity.; H.B. 2105, 2011Session. Available at <http://lis.virginia.gov/cgi-bin/legp604.exe?111+sum+hb2105>

should be offered.<sup>52</sup> Additionally, a bill has been introduced in the Council of the District of Columbia that would exempt EV charging service companies and service providers from regulation as public utilities.<sup>53</sup>

## **KEY POLICY ISSUES AND CURRENT STATUS**

Unless otherwise noted, the issues discussed below pertain to commercial EV charging stations, not residential charging. Table 5-1 contains a summary listing of the current laws and regulations in Maryland, Virginia, and the District of Columbia that address the issues raised in this subsection.

### **Regulation as a Public Utility**

One could interpret some state public utility regulations governing the provision of electric service as applying to EV charging service providers because the charging service they provide is powered by electricity. If an EV charging station were deemed to be subject to public utility regulation, the state utility commission would have authority to set its rates and fees, requiring a formal administrative process for any changes. In addition, the commission could set other terms and conditions for the provision of charging service. The service that an EV charging station provides is not equivalent to that of a public utility and does not warrant the same high level of oversight and regulation. However, the lack of a clear state policy can impede the EV charging market in a given state if EV charging station owners or operators are faced with regulatory uncertainty. The jurisdiction regulatory status for Maryland, Virginia, and the District of Columbia are discussed below.

**Maryland.** In Maryland, a number of EV-related bills were proposed during the 2012 legislative session as a result of recommendations made by the Governor’s Electric Vehicle Infrastructure Council. Legislation was enacted that exempts EV charging service providers from the definition of “electricity supplier” and “public service company” in the Public Utilities Article of the state code.<sup>54</sup>

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<sup>52</sup> District of Columbia Public Service Commission. Formal Case No. 1096, In the Matter of the Investigation into the Regulatory Treatment of Providers of Electric Vehicle Charging Stations and Related Services. Available at [http://www.dcpsc.org/edocket/docketsheets.asp?cbofctype=all&CaseNumber=FC1096&ItemNumber=&orderno=&PartyFiling=&FilingType=&yr\\_filing=&Keywords=&FromDate=&ToDate=&toggle\\_text=Full+Text&show\\_result=Y&hdn\\_orderNumber=&hdn\\_chk\\_whole\\_search=&hdn\\_AssesmentType=](http://www.dcpsc.org/edocket/docketsheets.asp?cbofctype=all&CaseNumber=FC1096&ItemNumber=&orderno=&PartyFiling=&FilingType=&yr_filing=&Keywords=&FromDate=&ToDate=&toggle_text=Full+Text&show_result=Y&hdn_orderNumber=&hdn_chk_whole_search=&hdn_AssesmentType=)

<sup>53</sup> Council of the District of Columbia. Energy Innovation and Savings Amendment Act of 2012. Available at <http://dcclims1.dccouncil.us/lims/searchbylegislation.aspx>.

<sup>54</sup> Maryland General Assembly. Senate. Public Utilities – Electric Vehicle Users and Charging Stations – Exclusions. H.B. 1280, 2012 Session. Available at <http://mlis.state.md.us/2012rs/billfile/hb1280.htm>

**Virginia.** Virginia’s General Assembly passed legislation regarding EV charging service in 2011. The law exempts EV charging service providers from being regulated as public utilities.<sup>55</sup>

**District of Columbia.** In the District of Columbia, the PSC will consider the regulatory treatment of electric vehicle charging stations and related services in its ongoing EV case.<sup>56</sup> In April 2012, a bill was introduced to the Council of the District of Columbia that would exempt EV charging station service companies and service providers from regulation as public utilities.<sup>57</sup>

### **Resale of Electricity**

Whether EV charging station owners/operators are deemed by the law to be reselling electricity or to be using electricity to provide a service will impact how EV charging stations are allowed to operate and charge for their services. If they were determined to be in the business of reselling electricity, EV charging stations would need to be licensed by the state public utility commission. The status of this issue in Maryland, Virginia, and the District of Columbia is discussed below.

**Maryland.** In Maryland, the recently passed legislation that exempts EV charging service providers from being regulated as utilities also exempts them from regulation as electricity suppliers. Thus, EV charging station owners and operators do not need to be licensed by the PSC in order to provide charging services.<sup>58</sup>

**Virginia.** Virginia’s public utility laws explicitly deem EV charging service providers not to be engaged in the retail sale of electricity, provided that they purchase 100 percent of the electricity used from the incumbent utility within the given exclusive service territory and the electricity is used solely for transportation purposes.

**District of Columbia.** Currently, only retail suppliers licensed by the PSC may sell electricity in the District of Columbia. This issue may be addressed by the ongoing EV case before the PSC.

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<sup>55</sup> Virginia General Assembly. Public Utilities—Electric Vehicle Charging Service; Excludes Certain Persons from Retail Sale of Electricity.; H.B. 2105, 2011Session. Available at <http://lis.virginia.gov/cgi-bin/legp604.exe?111+sum+hb2105>

<sup>56</sup> District of Columbia Public Service Commission. Formal Case No. 1096, In the Matter of the Investigation into the Regulatory Treatment of Providers of Electric Vehicle Charging Stations and Related Services. Available at [http://www.dcpsc.org/edocket/docketsheets.asp?cbofctype=all&CaseNumber=FC1096&ItemNumber=&orderno=&PartyFiling=&FilingType=&yr\\_filing=&Keywords=&FromDate=&ToDate=&toggle\\_text=Full+Text&show\\_result=Y&hdn\\_orderNumber=&hdn\\_chk\\_whole\\_search=&hdn\\_AssesmentType=](http://www.dcpsc.org/edocket/docketsheets.asp?cbofctype=all&CaseNumber=FC1096&ItemNumber=&orderno=&PartyFiling=&FilingType=&yr_filing=&Keywords=&FromDate=&ToDate=&toggle_text=Full+Text&show_result=Y&hdn_orderNumber=&hdn_chk_whole_search=&hdn_AssesmentType=)

<sup>57</sup> Council of the District of Columbia. Energy Innovation and Savings Amendment Act of 2012. Available at <http://dcclims1.dccouncil.us/lims/searchbylegislation.aspx>.

<sup>58</sup> Maryland General Assembly. Senate. Public Utilities – Electric Vehicle Users and Charging Stations – Exclusions. H.B. 1280, 2012 Session. Available at <http://mlis.state.md.us/2012rs/billfile/hb1280.htm>

## **Notification/Release of Records**

Currently, EV manufacturers and dealers are utilities' main source of information on EV sales in the region. However, this information does not give a complete picture of where vehicles are being charged. Data about residential charging stations are particularly important because studies indicate that 80 percent to 95 percent of EV charging occurs at home. Because potential immediate grid impacts of EV charging are local, complete and accurate data about home charging are essential to distribution planning efforts.

Electric permitting and inspection documents are likely to catch most new stand-alone EV charging locations. However, all vehicles will be able to charge using 120-volt outlets, and some consumers may not install Level 2 charging equipment. Currently, many electric permits do not indicate whether the new installation is for EV charging or for some other purpose. Including a checkbox on each permit indicating whether or not EV charging equipment was installed, as well as fields for the voltage and amperage, would greatly assist utilities in infrastructure planning. The regulatory status of this issue in Maryland, Virginia, and the District of Columbia is discussed below.

**Maryland.** Maryland's 2012 legislature enacted legislation that allows the Motor Vehicle Administration to provide electric utilities with the address of each registered EV owner in the state.<sup>59</sup>

**Virginia.** Virginia does not have an official utility notification policy. However, Virginia Clean Cities and the Virginia Department of Mines, Minerals and Energy were awarded a grant for EV infrastructure planning through the Department of Energy (DOE). This issue will be addressed as part of this effort, known as the Richmond Electric Vehicle Initiative (REVi).

**District of Columbia.** The District of Columbia does not have an official utility notification policy.

## **Utility Programs on EV Tariffs and Education**

Some states in the region have experimented with special EV charging rates, and others are considering developing programs. These programs allow utilities to collect valuable charging data from participants and assess the effectiveness of price signals in encouraging off-peak charging. In addition, special EV tariffs offer EV owners opportunities to lower fuel costs. These programs need approval by state utility commissions.

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<sup>59</sup> Maryland General Assembly. House of Delegates. H.B. 1279 Motor Vehicle Administration - Plug-In Vehicles - Disclosure of Personal Information. Available at <http://mlis.state.md.us/2012rs/billfile/HB1279.htm>

Several utilities are developing education programs to provide their EV customers with information related to the development and deployment of EVs. Such programs may include website information, speakers bureaus, community outreach, and electronic or paper education materials that are available to EV owners, potential EV owners, and the general public. Utilities are in a unique position to help educate current and potential EV owners because of their existing customer relationships. Therefore, utilities can be helpful partners with EV manufacturers, charging station managers, trade associations, and governments in developing education and outreach programs. These programs may be targeted to specific customer segments, such as residential, commercial, industrial, government, or fleet customers. Program offerings in Maryland, Virginia, and the District of Columbia are outlined below.

**Maryland.** In Maryland, Pepco offers special EV rates for commercial customers under “Schedule EV.” In addition, a law passed in 2011 requires the PSC to develop a pilot incentive program for residential, commercial, and government electric customers to charge EVs during off-peak hours. The program must be in place by June 30, 2013.<sup>60</sup>

**Virginia.** In Virginia, Dominion Virginia Power offers an EV Pilot Program that was approved by the SCC in July 2011 and became effective in October 2011. The program offers two rates for residential customers who own EVs. The Electric Vehicle Pricing Plan (Schedule EV) offers customers lower rates during off-peak hours, provided that a separate, dedicated EV meter is installed in the home. The Electric Vehicle + Home Pricing Plan (Schedule 1EV) offers time-of-use pricing for the entire home, including the vehicle, using a single whole-house meter.<sup>61</sup>

**District of Columbia.** The District of Columbia does not currently have a special rate for EVs. Pepco offered two experimental EV rates from 1993 until 2006, when they were eliminated due to low participation. The EV case now before the PSC will consider reinstating an EV pilot rate.<sup>62</sup>

### **Emissions Impacts**

EVs can offer significant emissions reductions over conventional vehicles. They produce no tailpipe emissions, thereby reducing urban concentrations of carbon monoxide, volatile organic compounds, oxides of nitrogen, sulfur oxides, and particulate matter. They can also offer

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<sup>60</sup> Pepco. Maryland Electric Vehicle Service Schedule EV. [http://www.pepco.com/\\_res/documents/MDRatesEV.pdf](http://www.pepco.com/_res/documents/MDRatesEV.pdf)

<sup>61</sup> Dominion. Plug In Electric Vehicles. Available at <https://www.dom.com/about/environment/electric-vehicles.jsp>

<sup>62</sup> District of Columbia Public Service Commission. Formal Case No. 1096, In the Matter of the Investigation into the Regulatory Treatment of Providers of Electric Vehicle Charging Stations and Related Services. Available at [http://www.dcpsc.org/edocket/docketsheets.asp?cboftype=all&CaseNumber=FC1096&ItemNumber=&orderno=&PartyFiling=&FilingType=&yr\\_filing=&Keywords=&FromDate=&ToDate=&toggle\\_text=Full+Text&show\\_result=Y&hdn\\_orderNumber=&hdn\\_chk\\_whole\\_search=&hdn\\_AssesmentType=](http://www.dcpsc.org/edocket/docketsheets.asp?cboftype=all&CaseNumber=FC1096&ItemNumber=&orderno=&PartyFiling=&FilingType=&yr_filing=&Keywords=&FromDate=&ToDate=&toggle_text=Full+Text&show_result=Y&hdn_orderNumber=&hdn_chk_whole_search=&hdn_AssesmentType=)

significant greenhouse gas reductions, depending on the electricity sources that are used to charge them.

The extent to which EV use reduces estimated upstream emissions—that is, total emissions from electricity production—is determined by the mix of energy sources used to power the local electrical grid and when EV owners recharge their vehicles. EVs charged in areas using a greater percentage of clean and/or renewable energy sources will have lower estimated upstream emissions impacts than EVs charged in areas depending heavily on conventional fossil fuel generation.

On the basis of the 2005 national average of fuel sources, EVs offer a 38 percent reduction in annual greenhouse gas emissions compared with conventional vehicles. A DOE emissions comparison module based on 2005 annualized electrical grid data shows that EVs produce a 44 percent reduction in greenhouse gas emissions when charged in the District of Columbia and Virginia and a 24 percent reduction when charged in Maryland. The reduction estimates are higher when 2009 or 2011 data are used. As the proportion of clean and renewable fuels used to produce electricity in the region increases, the benefits of EV deployment increase as well. Utilities across the region are making progress toward state renewable portfolio standard (RPS) goals, and many have implemented their own renewable and clean energy programs. State and local initiatives to increase installations of solar panels and other renewable energy technologies are also helping decrease the emissions intensity of electricity provided to the region. Continued government support for these initiatives is critical to increasing the environmental and health benefits of EV use over time. Goals for Maryland, Virginia, and the District of Columbia are highlighted below.

**Maryland.** Maryland has set an RPS goal of producing 20 percent of its electricity from renewable sources by 2022.

**Virginia.** Virginia has a voluntary RPS of producing 15 percent of base year 2007 electricity sales from renewable sources by 2025.

**District of Columbia.** The District of Columbia's RPS calls for 20 percent of electricity sales to come from renewable sources by 2020.

**Table 5-1**  
**Overview of State Laws and Regulations Related to EVSE**

	<b>Maryland</b>	<b>District of Columbia</b>	<b>Virginia</b>
<b>Regulation as a Public Utility</b>	Legislation has been passed exempting electric vehicle charging station (EVCS) owners, EVCS service companies, and EVCS service providers from the definition of “electricity supplier” and “public service company” in the Public Utilities Article ( <a href="#">H.B. 1280</a> and <a href="#">S.B. 997</a> ).	The DC Council is considering a bill that would exempt EVCS service providers from public utility regulation. ( <a href="#">Energy Innovation and Savings Amendment Act of 2012</a> ).	The Virginia General Assembly passed legislation in 2011 that deems the provision of EV charging services to be a permitted utility activity, but it exempts EVCS service providers from being regulated as public utilities. ( <a href="#">House Bill 2105</a> , 2011, and <a href="#">Virginia Code 56-1.2</a> and <a href="#">56-232.2</a> )
<b>Sale of Electricity for EV Charging</b>	Only electric suppliers licensed by the PSC can sell electricity.	Only retail suppliers licensed by the PSC can sell electricity.  The DC PSC is considering regulatory treatment of EVs and EVCS owners in <a href="#">Formal Case #1096</a> .	Under the 2011 law, EV charging service providers are deemed not to be engaged in the resale of electricity, provided that they purchase 100 percent of the electricity used to provide EV charging services from the incumbent electric utility in the given service territory and that the electricity purchased is used solely for transportation. ( <a href="#">House Bill 2105</a> , 2011, and <a href="#">Virginia Code 56-1.2</a> and <a href="#">56-232.2</a> )
<b>Release of Records</b>	Legislation has been passed to allow the Motor Vehicle Administration to release street addresses to utilities to ensure public safety and reliability of the electric grid ( <a href="#">H.B. 1279</a> and <a href="#">S.B. 998</a> ).	Has not been addressed.	This issue will be addressed as part of DOE’s EV Readiness Grant awarded to the Greater Richmond Region.
<b>Rates/Tariffs</b>	Pepco offers an EV rate for commercial customers under <a href="#">Schedule EV</a> .  The <a href="#">PSC Rate Case 9261</a> established a working group to consider rate-based incentives and pilot programs.	No special rate for EV.  PSC Case has been opened ( <a href="#">Case #1096</a> ).	<a href="#">Dominion EV Rate Pilot Program</a> was approved by the VA SCC in July 2011 and became effective in October 2011. Offers two rate options specifically designed for customers with EVs: (1) a whole-house time-of-use rate and (2) a separately metered EV-only rate. Each option is open to 750 participants. The pilot will be in effect for three years.



## **FUTURE EV ISSUES**

Electric utilities and other stakeholders foresee a number of issues relevant to EVs and grid planning that are important to consider as EV infrastructure grows. These issues do not require policy change at this time but are most appropriately dealt with by the private sector. Local and state governments should monitor these issues, should the need for regulation arise in the future.

### **Preparing for DC Fast Charging**

DC fast charging infrastructure requires special equipment and has a greater potential to impact utility transformers than do Level 1 and Level 2 charging stations. However, only two EV models available in the United States have DC fast charge capability, so while DC fast charging infrastructure is an important issue for future planning, it is not currently a pressing concern. More future vehicles are expected to have DC fast charge capabilities.

Because of the increased risk of electric infrastructure impacts and the planning that is necessary for DC fast charging, utilities need advance notice of specific deployment plans for DC fast charging installations. For the foreseeable future, DC fast charge stations will not be installed in homes, so this issue applies solely to nonresidential public and private charging stations.

The Society of Automotive Engineers (SAE International) just finalized the North American DC fast charging standards. However, vehicles will not be equipped with the standardized charging receptacle until at least late 2013. Because the charging connection standard will impact what charging equipment is appropriate, local governments and fleet owners should consider waiting for the introduction of vehicles equipped with the new standard receptacle before making large investments in DC fast charging infrastructure.

### **Cost to Charge EVs at Public Charging Stations**

A range of public charging options is available in the region, including pay services and free charging. At this early stage of the market, providing this variety of options is important to test various charging rates and structures. Providing free services is an important component of the market and should be preserved as a charging option.

### **Deployment of "Smart" EVSE**

There has been considerable interest in linking EVs with smart grids to better manage electrical loads. However, some charging stations being sold in the market today are not capable of two-way communication with the grid and thus are not smart-grid-ready. While EVs may one day play a significant role in smart-grid development, it is too early in the marketing of both technologies to regulate how they might be connected. Thus, there should not be any restrictions on non-smart-grid-ready EVSE technology.

### **Use of a Second Meter or Multiple Meters for EV Electric Consumption Billing**

Many commercial and multiunit residential buildings use multiple electricity meters to measure consumption in various areas or uses. In addition, some EV tariffs and rate schedules may require a separate meter for EV charging equipment. Separate metering may allow EV drivers to take advantage of the most cost-effective rates. Preserving the current regulatory flexibility is important, since it allows for multiple technological solutions to metering and billing.

## **UTILITY POLICY RECOMMENDATIONS**

**Recommendation 1: State governments and regulatory bodies should promote a clear regulatory framework for EV charging service providers that exempts them from regulation as electric utilities or retail sellers of electricity.**

- a. Do not regulate nonutility EV charging service providers as public utilities or electricity suppliers.
- b. Because EVSE providers are offering a service and not just electricity, do not consider that service to be a “sale for resale” or the “retail sale of electricity” subject to state/local electric provider regulations as long as EV charging service providers meet any existing conditions in state law that exempt the provision of EV charging services from treatment as a “sale for resale” or the “retail sale of electricity.”

**Recommendation 2: Local governments should notify utilities of EVSE installations.**

- a. Include a field on all new electrical permits noting whether the permit includes EV charging and if so, its voltage and amperage. If the field is checked on the permit, share the information with the local utility.
- b. Notify utilities in advance about the locations of new Level 2 or DC fast charge charging stations.
- c. Develop a statewide public charging station registry.

**Recommendation 3: State and local governments, in cooperation with utilities, should reduce upstream emissions associated with EV charging.**

- a. Continue to support clean and renewable energy programs that reduce the emissions intensity of electricity production in the region and thereby decrease the estimated indirect upstream emissions associated with EV use.

**Recommendation 4: Federal government entities, in cooperation with standards development organizations, should develop communications protocols for “smart” EVSE.**

- a. Encourage standards development organizations, working with federal government entities, to develop communications protocols for EVSE.
- b. Encourage state and local governments not to prohibit the sale of EVSEs that are not smart-grid-ready, so as not to interfere with the market.

**Recommendation 5: State governments and regulatory bodies, in cooperation with utilities, should allow a variety of metering and billing scenarios for EV charging.**

- a. Encourage regulatory flexibility to allow multiple technological solutions to metering and billing issues.
- b. Do not prevent or prohibit the use of second meters, since in some instances they may provide the most cost-effective option.

**Recommendation 6: State regulatory bodies and utilities should enable and promote utility EV pilot programs.**

- a. Encourage customers who have purchased an EV or are considering the purchase of an EV to participate in utility pilot programs.
- b. Support state regulatory approval of such programs, including the establishment of EV-specific tariffs for residential, commercial, industrial, and governmental customers.

**Recommendation 7: Utilities, in partnership with OEMs and stakeholders, should promote EV education programs.**

- a. Encourage participation in or partnership with utility education programs.
- b. Research the possibility of joint programs to expand and improve their outreach and impact.

## SECTION 6

### VEHICLE FLEETS

Government and commercial fleets offer a significant potential market for electric vehicles (EVs). Fleet purchases have a number of advantages:

- Fleet purchases reduce costs by taking advantage of economies of scale.
- Fleet purchases can help promote the adoption of new technology, as compressed natural gas fleets did in the past.
- Fleets have advantages over passenger vehicles that allow them to overcome problems faced by household consumers.
- Fleets operate in a defined geographic area, often service fixed routes, and return to a central location in the evening, thereby addressing concerns about range and charging infrastructure locations faced by private EV owners. Postal delivery trucks, utility service trucks, and consumer sales vehicles have these fleet characteristics.

This section explores the advantages of EVs for fleet use, highlights the EV public fleets now in use in the metropolitan Washington region, and discusses the current and planned use of EVs in private fleets in the region. Finally, recommendations related to promoting EV fleets are presented—primarily focused on using financing and tax incentives to reduce the cost and utilization of EVs in fleets and promoting sharing of charging stations and cooperative purchasing.

#### **BENEFITS OF EVS FOR FLEET USE**

A 2012 survey of fleets in the metropolitan Washington region found that EVs are being adopted slowly. The Greater Washington Region Clean Cities Coalition’s survey of 11 fleet managers found that most EVs currently in operation are used onsite, such as trucks used on landfills or campus landscaping equipment.<sup>63</sup> According to the Coalition, fleet managers cite the cost of EVs and infrastructure as obstacles to purchasing additional EVs.

The Electrification Coalition prepared a report, *Fleet Electrification Roadmap (2010)*,<sup>64</sup> which presents six major advantages of EVs over internal combustion vehicles for commercial and government fleet use. One of the main advantages is the lower total cost of ownership (capital, operating, maintenance, and service costs). Fleets also may lend themselves to electrification due

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<sup>63</sup> Greater Washington Regional Clean Cities Coalition. *Clean Cities 2011 Annual Report*. Spring 2012.

<sup>64</sup> Electrification Coalition. *Fleet Electrification Roadmap*. November 2010. Available at <http://www.electrificationcoalition.org/sites/default/files/EC-Fleet-Roadmap-screen.pdf>

to characteristics such as route predictability, higher vehicle utilization rates, and more use of central parking and fueling facility.

The *Fleet Electrification Roadmap* also points out that EVs are flexible in their use of power generation because they can switch to a different fuel during a power supply shortage. Electricity can be generated from different sources such as natural gas, hydropower, wind, geothermal heat, and solar energy.

The Electrification Coalition looked at the characteristics of different fleets, such as service and utility vehicles and medium short haul vehicles. They concluded that fleet managers need efficient vehicles that can perform well under specified conditions. The report recommends tailoring the battery size for the task to get a vehicle that specifically fits the fleet's needs and is used efficiently. The analysis concludes that cost competitiveness increased over time for hybrid electric and plug-in hybrid electric vehicles compared with conventional internal combustion vehicles when the battery is sized according to fleet operating conditions.

## **PUBLIC FLEETS**

In 2010, the General Service Administration (GSA) initiated a Plug-in Electric Vehicle Pilot that will distribute 116 vehicles across nine cities, including the metropolitan Washington region. The program includes Chevy Volts, Nissan LEAFs, and Think City EVs. The 20 participating agencies are required to install one Level 2 charging station/connector per vehicle.

The metropolitan Washington region received 37 Chevy Volts. The first two Volts were delivered in October 2011, and the remaining 35 were delivered between February and May 2012. Through this pilot program, Baltimore

### **Figure 6-1 EPA 92 AFV Acquisition Requirements**

Under the Energy Policy Act of 1992 (EPA 92) certain federal, state, and alternative fuel provider fleets are subject to alternative fuel vehicle (AFV) acquisition requirements.

Under EPA 92, local government fleets are not subject to these requirements; however, the District of Columbia is considered a state under EPA 92 and is required to follow the state mandates.

AFVs include flex-fuel vehicles, compressed natural gas or propane dedicated or bi-fuel vehicles, and dedicated electric vehicles (EVs). To measure compliance, agencies receive credits for each light-, medium- or heavy-duty AFV they acquire each year. Section 133 of the Energy Independence and Security Act of 2007 proposes a credit allocation for hybrid, plug-in hybrid, fuel cell, and neighborhood EVs. The comment period on the notice of proposed rulemaking ended December 31, 2011. Preparation of the final rule is underway. Current AFV acquisition requirements under EPA 92 are as follows:

- State Fleets – **75 percent** of annual covered light duty vehicle (LDV) acquisitions
- Alternative Fuel Provider Fleets – **90 percent** of annual covered LDV acquisitions
- Federal Fleets – **75 percent** of annual covered LDV acquisitions

received five Think Citys in November 2011, with charging stations installed and operational by December 2011.

GSA's Federal Acquisition Service provides access to different types of alternative fuel vehicles, including compressed natural (CNG), ethanol (E85), and EVs. Through GSA Federal Vehicle Standards, GSA customers can acquire a variety of EVs and EVSE brands/models, installation services, and ancillary services. Figure 6-1 outlines the alternative fuel vehicle acquisition requirements of the EPA Act 1992 that apply to fleets. Figure 6-2 lists the available EVs that are compliant with GSA's federal vehicle standards.

#### PRIVATE FLEETS

Some regional corporate leaders support electricity as a transportation solution. Frito-Lay currently operates EV trucks in the metropolitan Washington region.

Enterprise Rent-A-Car is planning a large-scale EV rental rollout across several markets throughout the United States as part of their corporate commitment to sustainability. Enterprise also offers daily and weekly rentals of the Chevy Volt Extended-Range EV. Enterprise has introduced 500 Nissan LEAFs into the fleet, with an ongoing goal of incorporating new technology, such as the Toyota Prius Plug-In hybrids and Peugeot iOns, to be added in Enterprise Rent-A-Car's neighborhood locations, local business rental programs, and WeCar car sharing. (See Appendix F for more information on car-sharing programs in the region.) Within the metropolitan Washington region, the [Downtown DC Enterprise location](#) offers hybrid and/or EV rentals. Enterprise is considering providing public charging at rental locations in the near future. In addition, Enterprise is installing Level 2 charging stations at a number of metropolitan Washington region area rental branches to support a growing fleet of EVs.

#### Figure 6-2 Available EV Products on GSA's Federal Vehicle Standards

##### Light-Duty Hybrid

- Sedans: Honda Insight, Toyota Prius, Ford Fusion, RP Automotive Hyundai Sonata
- SUV (4x2 and 4x4): Ford Escape, Chevrolet Tahoe
- Pickup (4x2 and 4x4): Chevrolet Silverado

##### Electric Vehicles

- Sedans: Chevrolet Volt, RP Automotive Nissan LEAF, RP Automotive Mitsubishi iMiev, Ford Focus Electric
- Cargo Vans/Trucks: Smith Electric Newton, Central Truck Zero, EVI, Boulder, eStar

##### EVSE (as of 1/12/2012)

- ClipperCreek, Coulomb Technologies, Eaton, Leviton, Merit Builders, Schneider Electric, Siemens

## **FLEETS RECOMMENDATIONS**

Below are recommendations related to promoting increased use of public and private EV fleets.

### **Recommendation 1: Federal, state, and local governments, in cooperation with original equipment manufacturers (OEMs), should work to reduce the cost and increase the utilization of EVs in fleets.**

- a. Adopt measures to increase the use and acquisition of EVs in fleets by leveraging public and private funding. Offset fleet EV vehicle acquisition costs by using available grant funding of up to 20 percent to be competitive.
- b. Use federal and state financing and tax incentives and implement other incentives to reduce parking fees, permitting fees, and registration fees, and expand HOV access.
- c. Expand the tax credit for light, medium, and heavy duty vehicles for corporations, and encourage metropolitan Washington region dealers to extend the reduced pricing to public fleets.
- d. Support the extension of existing federal tax credits for EV infrastructure through 2018.
- e. Create clean renewable energy bonds for fleet vehicle infrastructure financing for fleets with more than 10 vehicles.
- f. Support advanced battery and related research and development (R&D).
- g. Encourage public and private fleet managers to consider the total value of EV ownership, such as lower fuel and maintenance costs as well as nonmonetary benefits.

### **Recommendation 2: Governments, OEMs, and businesses should encourage sharing and alternate EV charging station arrangements.**

- a. Encourage fleets that operate in large geographic areas to develop working relationships with federal agencies/commercial interests having charging stations in strategic locations throughout the service area.
- b. Encourage installation of Level 2, on-street public charging.
- c. Encourage locating employer workplace charging such that fleet vehicles and other public EVs could utilize if available.
- d. Encourage utility and private firms to consider installing EVSE networks with monthly subscription rates for unlimited charging.

### **Recommendation 3: Federal, state, and local governments should promote cooperative purchasing.**

- a. Utilize GSA, COG, or other cooperative procurement agreements and mechanisms to reduce acquisition costs and to advance adoption of EVs.
- b. Offer incentives, such as tax credits, for fleet owners who convert fleet vehicles to electric.



**Recommendation 4: Public fleet owners, OEMs, and businesses should become more engaged in development of EV charging policy.**

- a. Engage in the regulatory treatment of EV charging stations—such as supporting model ordinances—as an effective way to influence EV charging policy.

## SECTION 7

### OUTREACH AND EDUCATION

A significant information gap exists among the driving public regarding the benefits of EVs compared with those of conventional vehicles. Education efforts by private and public entities (including nongovernmental organizations, electric utilities, plug-in electric vehicle [PEV] service providers, auto dealers, other businesses, and government) are needed to bridge the gap.<sup>65</sup> To set the stage for EV marketplace success in the National Capital Region, regional partners involved in the Metropolitan COG Electric Vehicle Planning Initiative have identified key target audiences and information needs for those audiences.

This section first defines the various target audiences and their information needs related to EV adoption. Then public safety training needs and national and regional training resources for emergency responders, the EV service community, consumers, and the general public are discussed. Finally, recommendations are presented that are intended to bridge the information gap between EV and conventional vehicle technology by identifying and promoting relevant resources and encouraging continued collaboration and sharing of best practices among interested parties.

#### EV EDUCATION TARGET AUDIENCES

**Consumers.** Ultimately, marketplace success is determined by consumers. Messaging should reflect how easy it is to own an EV/PEV and how it can fit into the consumer's lifestyle. This could include information on what to consider prior to buying a EV, Level 1 charging at home, home safety and inspection, and information that will help alleviate range anxiety.

**Property Owners and Managers.** This target audience includes all types of property owners and managers such as multifamily, commercial, institutions, and homeowner/condominium associations. Property owners and managers need information on how to locate a charging station at their property. Property owners and managers with charging stations can assist in relieving consumers of range anxiety. Businesses that are interested in purchasing or leasing an EV may need information on EV fleet capabilities appropriate for their needs.

**Service Industry.** This target audience incorporates total vehicle service and includes charging station installers, charging station inspectors, car dealerships, repair shops, and first responders. If EVs are going to be successful in the marketplace, the service industry needs to understand how to accommodate EVs. Education and training are needed on installing and inspecting

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<sup>65</sup> Center for Climate and Energy Solutions. *An Action Plan to Integrate Plug-in Electric Vehicles with the U.S. Electrical Grid*. March 2012. Available at <http://www.c2es.org/docUploads/PEV-action-plan.pdf>

charging stations. Car dealerships need to be able to provide EV owners and potential buyers with accurate information, and mechanics need training on how to repair PEVs. First responders need to know how to respond to an emergency involving an EV.

**Students.** Educating the next generation on EV technology will assist in bridging the technology gap. The target audience includes elementary, middle, high school, and college students.

**EV Owners/Enthusiasts.** EV owners can be champions in their community just by sharing their experience as an owner. Public and private entities engaging consumers in PEV education may want to consider tapping into this resource and encouraging owners to participate in outreach events.

All target audiences need information on available incentives and on EV charging stations, including locations, etiquette, and payment mechanisms as well as charging station installation, inspection, and maintenance. Messaging should also recognize that driving less and alternative commuting are key to reducing greenhouse gas emissions and congestion.

## **PUBLIC SAFETY**

Although as safe as conventional vehicles, high-voltage EVs pose a new set of concerns for first responders when approaching an accident scene. Knowing that firefighters and first responders are equipped with the necessary safety information for EVs is crucial to public acceptance. It is important that those connected with fire services and first responders are educated on how to safely work with the inherent differences of EVs. EV have wires, battery packs, and drive train components that can be up to 600V, which can lead to injuries to first responders if not handled properly.

It is important to develop an EV public safety program that is comprehensive, standardized, and consistent. Typical training sessions are eight hours and are geared to educate firefighters on how to act efficiently in emergencies involving electric and hybrid vehicles. Most safety training courses cover vehicle identification and configuration of hybrid electric, plug-in hybrid electric, and battery electric vehicles; overview of components and characteristics; safety features; and recommended extractions procedures for first responders.

### **National Safety Training Programs**

In 2010, the National Fire Protection Association (NFPA) received a \$4.4 million grant from the U.S. Department of Energy (DOE) to develop an Electric Vehicle Safety Program.<sup>66</sup> The NFPA

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<sup>66</sup> National Fire Protection Association. *Electric Vehicle Safety Training*. Available at <http://www.evsaftytraining.org/about-us.aspx#>

project supports DOE's aim to increase the number of EVs on the road. The training is offered to members of the fire service, law enforcement, and emergency medical services personnel. The NFPA safety program offers computer-based training courses, self-based study, and webinars that can be taken on a home computer or on a smart phone. The program has identified risks, procedures, and various scenarios ranging from water submersion to in-structure fires and power lines. Through the NFPA program, fire departments will also have access to safety information published by the auto manufacturers.

NFPA expects to train state and metro fire trainers and first responders to deliver course content and curricula. The distribution plan will consist of a train-the-trainer program, including a kit that will be distributed to 60,000 fire departments via the NFPA web portal. NFPA also offers a webinar course, which reviews the safety steps for installation of EV supply equipment.

In January 2012, the National Highway Traffic Safety Administration (NHTSA) released a report called *Interim Guidance for Electric and Hybrid-Electric Vehicles Equipped with High Voltage Batteries*.<sup>67</sup> Prepared in cooperation with DOE and NFPA, the report identifies appropriate postcrash safety measures for vehicle owners and the general public, emergency responders, and towing/recovery operators and vehicle storage facilities. NHTSA also offers more targeted, user-friendly guidance for consumers,<sup>68</sup> the emergency response community,<sup>69</sup> and tow truck operators and storage facilities.<sup>70</sup>

### **Regional Safety Training Programs**

The [National Alternative Fuels Training Consortium \(NAFTC\)](#) is a nationally recognized program offering a menu of training courses on advanced vehicle technology and products from biofuel, gaseous fuel, hydrogen, and EVs. Headquartered in West Virginia, the consortium operates through a network of National Training Centers and Associate Training Centers across the United States.

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<sup>67</sup> National Highway Traffic Safety Administration. *Interim Guidance for Electric and Hybrid-Electric Vehicles Equipped with High Voltage Batteries*. January 2012. Available at [http://www.evsaftytraining.org/Resources/~media/Files/PDFs/NHTSA%20Interim\\_Guidance\\_ELECTRIC%20and%20HYBRID%20VEHICLES.pdf](http://www.evsaftytraining.org/Resources/~media/Files/PDFs/NHTSA%20Interim_Guidance_ELECTRIC%20and%20HYBRID%20VEHICLES.pdf)

<sup>68</sup> National Highway Traffic Safety Administration. *Interim Guidance for Electric and Hybrid-Electric Vehicles Equipped with High Voltage Batteries*. January 2012. Available at [http://www.evsaftytraining.org/Resources/~media/Files/PDFs/NHTSA%20Interim\\_Guidance\\_Consumers.pdf](http://www.evsaftytraining.org/Resources/~media/Files/PDFs/NHTSA%20Interim_Guidance_Consumers.pdf)

<sup>69</sup> National Highway Traffic Safety Administration. *Interim Guidance for Electric and Hybrid-Electric Vehicles Equipped with High Voltage Batteries (Law Enforcement/Emergency Medical Services/Fire Department)*. Available at [http://www.evsaftytraining.org/Resources/~media/Files/PDFs/NHTSA%20Interim\\_Guidance\\_Emergency%20Response.pdf](http://www.evsaftytraining.org/Resources/~media/Files/PDFs/NHTSA%20Interim_Guidance_Emergency%20Response.pdf)

<sup>70</sup> National Highway Traffic Safety Administration. *Interim Guidance for Electric and Hybrid-Electric Vehicles Equipped with High Voltage Batteries (Towing and Recovery Operators and Vehicle Storage Facilities)*. Available at [http://www.evsaftytraining.org/Resources/~media/Files/PDFs/NHTSA%20Interim\\_Guidance\\_Tow.pdf](http://www.evsaftytraining.org/Resources/~media/Files/PDFs/NHTSA%20Interim_Guidance_Tow.pdf)

National Training Centers are postsecondary education and training organizations that provide instruction and a demonstrated commitment providing instruction in alternative fuels, alternative fuel vehicles, advanced technology vehicles, and related technologies. Associate Training Centers include high schools, technical centers, and other organizations that provide secondary education. There are three National and Associate Training Centers in the greater Washington–Baltimore area:

- [Alexandria Campus–Northern Virginia Community College](#)
- [Electric Drive Transportation Association](#)
- [The Community College of Baltimore County](#)

NAFTC also offers dedicated workshops and online courses. The first responder safety course for EVs is offered only online.

### **Additional Resources**

For additional resources including safety guidance, as well as safety information from EV manufacturers, see [NFPA’s Electric Vehicle Safety Training resource page](#).

### **Original Equipment Manufacturer Training**<sup>71</sup>

- [Chevrolet Volt Emergency Response Guide](#)
- [Chevrolet Volt Emergency Responder Quick Reference Page Training Class Reference](#)
- [Chevrolet Volt Emergency Responder Quick Reference Guide](#)
- [General Motors High Strength Steel Reference Guide](#)
- [Chevrolet Malibu Eco Emergency Response Guide](#)

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<sup>71</sup> Electric Vehicle Safety Training. *Chevrolet*. Available at <http://www.evsafetytraining.org/Resources/Auto-Manufacturer-Resources/Chevrolet.aspx>

## **OUTREACH AND EDUCATION RECOMMENDATIONS**

Based on the target groups and needs identified, the following recommendations are intended to bridge the information gap between PEV and conventional vehicle technology:

### **Recommendation 1: Governments and stakeholders should identify and promote EV education and outreach resources.**

- a. Identify the main resources that address the needs of target audiences and share them with regional partners on a continual basis to ensure that reliable and consistent information is being provided across the region. Update the list regularly to ensure that new resources are incorporated as they are developed.
- b. Add more local resources as local governments develop policies and standards for EV charging stations and other regional partners move forward with their outreach efforts.
- c. Include the resources in the outreach and education section of Appendix C.

### **Recommendation 2: COG, state and local governments, and stakeholders should continue to engage regional EV partners to encourage collaboration, share experiences, and identify new best practices and resources.**

- a. Continue to convene to help facilitate implementation of the strategy, share resources, and collaborate on initiatives and events.

### **Recommendation 3: COG, state and local governments, and stakeholders should promote awareness of the emerging EV industry training and curricula.**

- a. Encourage service industry representatives to participate in EV courses that are offered by community colleges and training centers in the region.
- b. Encourage high school automotive programs to participate in available training.
- c. Make high school instructors aware of other available curricula, resources, and case studies such as the following:
  - The Advanced Electric Drive Toolkit, which features videos and PowerPoint presentations on EV history, orientation, and technologies
  - The National Sustainable Energy Association Curricular Units and Educational Materials
  - The National Renewable Energy Laboratory Model Car Competition for Students
  - Local competitions are organized by the Electric Vehicle Association of Greater Washington DC
  - Maryland Science Center Energy Efficient Car Exhibit
  - The Baltimore-Washington Electric Vehicle Initiative (BEVI) EV intern placement program
  - The Kansas school “SHS Chevy Volt Project”

- GM Electric vehicle school lesson plans, teachers guides, and games
- A year-long EVChallenge for high school students in North Carolina
- The Chevy Volt as a teaching aid video
- Chevrolet Invites Students Nationwide to an “Electric” Education

## SECTION 8

### SUMMARY OF RECOMMENDATIONS

Achieving electric vehicle (EV) readiness in the metropolitan Washington region will require a coordinated approach among local governments, utilities, players in the EV industry, and nonprofit groups. This report contains recommendations for these stakeholders to promote a consistent set of practices across the region that will remove barriers to EV adoption and infrastructure planning. The recommendations are summarized by topic below. Table 8-1 presents recommendations, along with some indication of cost, timeframe, and responsible party.

#### **EV AND EVSE DEPLOYMENT PLANNING**

The region needs guidelines and regulations that ensure that the built environment can easily accommodate future EV charging infrastructure. Special consideration should be given to the multifamily residential sector, workplace charging, and promoting EV use by facilitating tourism opportunities. Governments and companies can provide incentives to EV owners and charging station hosts to further promote EV deployment.

#### **LOCAL GOVERNMENT POLICY**

Local governments should ensure that their comprehensive plans address EV infrastructure development to elevate the issue among relevant departments and to provide context for negotiations with developers to secure vehicle charging station commitments. Design guidelines, zoning, and building codes should address issues such as ADA accessibility, safety, integration with public streets, and signage.

Local governments can contribute to a more EV-friendly policy environment by streamlining permitting and inspection procedures for EV charging installation. This would involve adopting a consistent set of permitting procedures for each EVSE type, developing guidance for installers, and instituting one-time fees.

#### **UTILITY PLANNING AND POLICY**

The region needs a consistent regulatory framework for EV charging service providers. State governments should clarify the regulatory status of EV charging service providers, exempting them from public utility laws and electricity resale provisions, and should allow utilities to establish EV rate pilot programs. Electric utilities should be notified of EVSE installations so they can provide necessary grid upgrades and protect service reliability. Notification through the electrical permitting process is preferred. Utilities may also play an important role in EV education programs.



## **FLEETS**

Financing and tax incentives should be used to reduce the cost and increase the utilization of EVs in vehicle fleets in the region. Coordinated efforts, including EV station sharing and cooperative purchasing, can keep down the cost of EV fleet deployment.

## **OUTREACH AND EDUCATION**

Stakeholders should continue to collaborate, share experiences, and identify new best practices as they arise. There is a need to identify existing outreach and education resources, both nationally and in the region, that address the needs of key audiences. Stakeholders can also help promote emerging EV industry trainings and curricula offered in the region.

**Table 8-1**  
**Recommendations List**

RECOMMENDATIONS	Cost of Implementation	Timeframe to Implement	Responsible Party
1. Promote EVSE siting in strategic locations and monitor EV use and EVSE installations.	M, L	I, NT, MT, LT	COG, FG, SG, LG, PNO
2. Equip major new construction and redevelopment in the commercial, multifamily, and public sectors with a feasible level of inexpensive technology to reduce the cost of future EVSE installation.	M, L	I	FG, SG, LG, U, PNO
3. Address multifamily residential EV charging challenges.	M, L	I	COG, OEMs, FG, LG, PNO
4. Facilitate workplace charging by identifying prime charging locations, connecting employers and property managers with EVSE installation resources, and building partnerships between businesses and EV industry players.	M, L	I	COG, FG, LG, PNO
5. Develop tourist market opportunities by increasing the availability of EV rentals and developing charging infrastructure at hotels and tourist destinations.	L	I	OEMs, LG, PNO
6. Offer incentives to promote investment in publicly accessible EV infrastructure.	H, M, L	I, NT	FG, SG, LG, PNO
7. Develop comprehensive plan guidance to guide EV infrastructure development.	L	I	LG
8. Amend all zones except conservation areas to allow for EV charging as an accessory, conditional, or principal use.	L	I	LG
9. Establish design criteria to address ADA accessibility, safety, and theft deterrence.	M, L	I	LG
10. Establish guidelines for integrating EV infrastructure with public streets and publicly accessible spaces.	L	MT	LG
11. Standardize signage for EV charging stations.	M	I	FG, SG, LG, PNO
12. Streamline the permitting process for EVSE installations.	M, L	I	LG, U
13. Develop a consistent set of permitting procedures for each EV charging scenario.	L	I	LG, U
14. Amend electrical permit applications to include a field noting whether the facility will include EV charging, and share this information with the local electric utility.	M	I	OEMs, LG, U
15. Promote a clear regulatory framework for EV charging service providers that exempts them from regulation as electric utilities or as retail sellers of electricity.	L	I	SG, RB,
16. Reduce upstream emissions associated with EV charging.	M	NT	SG, LG, U
17. Develop communications protocols for smart EV.	L	NT	FG, NP
18. Allow a variety of metering and billing scenarios for EV charging.	L	I	SG, LG, U, RB
19. Enable and promote utility EV rate pilot programs.	L	I	COG, OEMs,

			<b>SG, U, RB, PNO</b>
20. Reduce cost and increase utilization of EVs in fleets by leveraging public and private funding, innovative financing mechanisms, and tax incentives.	<b>M</b>	<b>NT</b>	<b>OEMs, FG, SG, LG</b>
21. Encourage infrastructure sharing and alternate EVSE arrangements for fleets.	<b>M</b>	<b>I</b>	<b>SG, LG, U, PNO</b>
22. Promote cooperative purchasing of EVs for fleets.	<b>L</b>	<b>I</b>	<b>COG, FG, SG, LG</b>
23. Identify and promote EV education and outreach resources.	<b>L</b>	<b>I, NT</b>	<b>COG, FG, SG, LG, NP</b>
24. Continue to engage regional EV partners to encourage collaboration, share experiences, and identify new best practices and resources.	<b>M</b>	<b>I, NT</b>	<b>COG</b>
25. Promote awareness of the emerging EV industry with training and curricula.	<b>L</b>	<b>I, NT</b>	<b>SG, NP</b>

H = high

M = medium

L = low

I = immediate (0–2yrs)

NT = near term (2–5 yrs)

MT = medium term (5–10 yrs)

LT = long term (10+ yrs)

COG = Council of Governments

OEM = original equipment manufacturer

FG = federal government

SG = state government

LG = local government

U = utility

RB = regulatory body

PNO = private (non-OEM)

NP = nonprofit

## APPENDIX A ABOUT COG

For more than 50 years, the Metropolitan Washington Council of Governments, known as COG, has helped develop regional solutions to issues including the environment, affordable housing, growth and development, public health, child welfare, public safety, homeland security, and transportation. Founded in 1957, COG is comprised of elected officials from 21 local governments, members of the Maryland and Virginia state legislatures, and members of the U.S. Congress. COG and its 21 member jurisdictions seek to create a more accessible, sustainable, prosperous, and livable National Capital Region.

The organization's overall mission is expressed in our vision plan titled *Region Forward*, which is a comprehensive framework that resulted from the Greater Washington 2050 Initiative. Endorsed by each of COG's 21 local member jurisdictions, *Region Forward* creates a coordinated approach for identifying, tackling, and measuring regional issues that are likely to improve the accessibility, sustainability, prosperity, and livability of communities throughout the region.

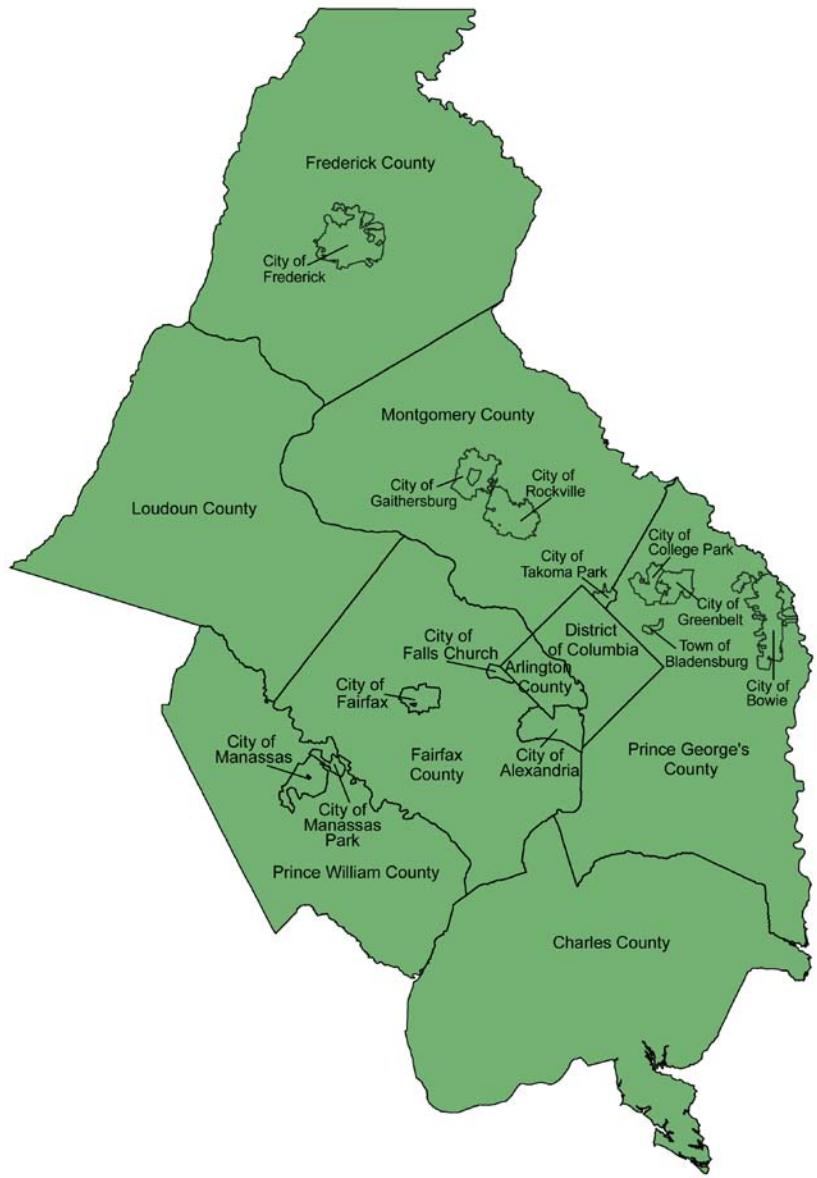
In addition to the *Region Forward* vision, COG has used its far-reaching relationships to create regional reports on a number of issues. The 2008 *National Capital Region Climate Change Report* addresses short- and long-term goals to reduce greenhouse gas emissions, ultimately to 80 percent below 2005 levels by 2050. The COG Transportation Planning Board's (TPB's) *The Vision* from 1998 lays out eight broad goals and a host of objectives and strategies to guide the region's transportation investments. The 2006 *COG Energy Strategic Plan* focuses on actions that COG and its members can take to help the region adjust to the rising demand for and tightening supply of global energy. The *Bicycle and Pedestrian Plan for the National Capital Region*, the *National Capital Region Freight Plan*, and the *Update of the Ground Access Element of the Washington–Baltimore Regional Airport System Plan*, all from 2010, show how the TPB is incorporating many transit modes and approaches into their comprehensive planning for the region.

The COG TPB is the federally designated Metropolitan Planning Organization for the region and serves as the regional forum for transportation planning. With participation from the District of Columbia and state departments of transportation and the region's local governments, the TPB prepares intermediate and long-range transportation plans and programs. In addition to the reports mentioned above, the TPB prepares the annual Constrained Long Range Plan (CLRP), which identifies all regionally significant transportation projects and programs that are planned in the metropolitan Washington region between 2010 and 2040. Numerous technical committees

provide information that contributes to recommendations and actions in the CLRP. The Transportation Improvement Program (TIP) is a six-year financial program that describes the schedule for obligating federal funds to state and local projects. The program is updated each year to reflect priority projects in the CLRP. The TIP serves as a schedule of accountability to the Federal Highway and Federal Transit Administrations.

In April 2009, the COG Board created the Climate Energy and Environment Policy Committee (CEEPC) to be its principal policy adviser on climate change, energy, green building, alternative fuels, solid waste and recycling policy issues. CEEPC is responsible for managing implementation of the *2008 National Capital Region Climate Change Report* mentioned above. That includes developing a regional climate change strategy to meet regional greenhouse gas reduction goals adopted by the COG Board.

After COG's EV Forum in April 2011, CEEPC determined that a regional electric vehicle (EV) strategy is a top priority for the region. Elected local government leaders who participated in COG's EV Forum are very interested in working with the Greater Washington Region Clean Cities Coalition and with the stakeholders who attended the forum—original equipment manufacturers, electric vehicle supply equipment manufacturers, Pepco, and Virginia Dominion Power, in particular—to continue to promote greater EV readiness in the region.



**Map of the COG Region**

## APPENDIX B

### GLOSSARY OF TERMS AND ACRONYMS

**alternating current (AC)**—A type of electric power commonly found in households or businesses where the electric charge constantly and cyclically reverses directions.

**alternative fuel**—As defined by the Energy Policy Act (EPA) of 1992, the following fuels are defined as alternative fuels: pure methanol, ethanol, and other alcohols; blends of 85 percent or more of alcohol with gasoline; natural gas and liquid fuels domestically produced from natural gas; liquefied petroleum gas (propane); coal-derived liquid fuels; hydrogen; electricity; pure biodiesel (B100); fuels, other than alcohol, derived from biological materials; and P-Series fuels.

**alternative fuel vehicle (AFV)**—A vehicle that runs on any form of alternative fuel, including electricity, solar energy, ethanol, or biodiesel.

**amperage**—The strength of an electrical current measured in amperes (amps).

**automatic start/shutoff**—An engine that automatically shuts off when the vehicle comes to a stop and restarts when the driver accelerates so energy isn't wasted during idling.

**battery electric vehicle (BEV)**—A battery-operated all-electric vehicle (electricity is stored in the batteries). BEVs generally have the highest all-electric range (e.g., 60–300 miles) and the largest battery capacity (e.g., 25–35 kWh) among EVs. Includes Nissan LEAF.

**DC fast charging**—A direct-current charging that uses a 480-volt connection to provide 50kW or more to EV batteries. It provides a full charge in less than 30 minutes, enabling charging along heavy traffic corridors and at public charging stations. The first generation of DC fast chargers primarily use the CHAdeMO connector, produced in Japan. However, in May 2012 the International Society of Automotive Engineers (SAE) designated a new plug design as the standard for American and European models. The new design, called DC Fast Charging with a Combined Charging System, offers a single port that is compatible with existing Level 1 and 2 plugs.

**direct current (DC)**—A type of electric power commonly found in batteries and solar cells where the electricity charge flows in one direction.

**electric motor assist**—Technology whereby the electric motor provides additional power to the engine during acceleration, passing, and hill climbing, and uses a smaller, more efficient energy conversion unit (engine).

**electric motor drive**—Technology whereby the electric motor alone provides the power for lower-speed driving.

**electric vehicle (EV)**—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.

**electric vehicle supply equipment (EVSE)**—Equipment used in charging electric vehicles.

**extended-range electric vehicle (E-REV)**—An electric vehicle with a relatively large battery (e.g., 16–27 kWh) capable of relatively long all-electric ranges (e.g., 40–60 miles) and with a back-up source of power such as gasoline or E85 ethanol. Includes Chevy Volt.

**fuel cell electric vehicles (FCEV)**—An electric vehicle that converts hydrogen stored onboard with oxygen from the air into electricity to power its electric motor.

**heavy duty motor vehicles**—A vehicle over 10,000 lbs. gross vehicle weight rating (GVWR).

**hybrid vehicle (HV)**—A vehicle that uses two or more power sources, usually with one fuel source such as gasoline and the other often a form of electricity stored in a battery.

**instantaneous demand**—The maximum electric demand at the instant of greatest load.

**kilowatt (kW)**—A unit of power measurement (1 watt = 1 joule/second; 1,000 watts = 1 kilowatt).

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

**Level 1 charging**—Standard 120 volts AC (VAC) branch circuit, which is the lowest common voltage level found in both residential and commercial buildings. Typical voltage ratings can be from 110 to 120 volts AC. Typical amp ratings for these receptacles are 15 or 20 amps.



**Level 2 charging**—Typically described as the “primary” and “preferred” method for the EVSE for both private and publicly available facilities. Level 2 charging specifies a single-phase branch circuit with typical voltage ratings from 220 to 240 volts AC.

**Level 3 charging**—A charging type that is still in development but is expected to provide a faster AC charging option at public stations. It would operate at a higher voltage and current than Level 2 EVSE. Level 3 charging is expected to deliver a full charge in less than 30 minutes.

**light duty motor vehicle**—A passenger car or light duty truck at or under 8,500 lbs. GVWR.

**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.

**medium duty motor vehicle**—A motor vehicle between 8,500 lbs. and 10,000 lbs. GVWR.

**neighborhood electric vehicle (NEV)**—A battery-charged EV with a given amount of speed of up to 25 mph in designated neighborhood areas; NEVs are great for small communities. Includes Columbia ParCar Mega, Dynasty IT, GEM E4, Miles ZX40S, Miles ZX40ST, and Zenn Standard.

**nickel metal hydride (NiMH)**—A rechargeable battery technology that uses the mineral nickel and a hydrogen-storing alloy to store and then deliver electrical energy.

**plug-in hybrid electric vehicle (PHEV)**—A hybrid vehicle that runs on an internal combustion engine with batteries that can be recharged by plugging into an external electric power source. They have larger batteries than traditional hybrid vehicles (e.g., 5–22 kWh), allowing for a longer all-electric range. Because they have hybrid engines, PHEVs effectively have an unlimited driving range.

**private charging stations**—Charging stations located on private property and available only to specified vehicle owners or specified vehicles.

**public charging station**—A station installed or operated by a public entity, whether publicly available or not.

**publicly accessible charging stations**—A charging station that is available to the wider public (which could be located on public or private property or operated by a public or private firm).

**regenerative braking**—Technology whereby energy normally lost during coasting and braking is converted into electricity and stored in the battery.

**voltage (V)**—A measure of electric potential, which is the condition that causes electric energy to flow; measured in volts.

**zero emissions vehicle (ZEV)**—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 super ultra low emissions vehicle and the partial zero emissions vehicle.

## APPENDIX C RESOURCES/LINKS

### LEADING PLANNING INITIATIVES

City of Houston. *Electric Vehicle Charging Long Range Plan for the Greater Houston Area*. Available at <http://www.greenhoustontx.gov/ev/pdf/longrangeevplan.pdf>

### BUILDING CODES, ZONING, PERMITTING, AND INSPECTIONS

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City of Raleigh. *How-To Charge Your Electric Car at Home* [YouTube video]. Available at <http://www.youtube.com/watch?v=x4YezUX8lo&lr=1&uid=makWAtClzgsRXZUNcZYNEA>

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Oregon Building Codes Division (BCD). *Minor Label Program*. Available at [http://www.bcd.oregon.gov/programs/minorlabel/minor\\_label\\_programs.html#2](http://www.bcd.oregon.gov/programs/minorlabel/minor_label_programs.html#2)

State of Washington Department of Commerce and Puget Sound Regional Council. *Electric Vehicle Infrastructure: A Guide for Local Governments in Washington State*. July 2010. Available at [http://www.psrc.org/assets/4325/EVI\\_full\\_report.pdf](http://www.psrc.org/assets/4325/EVI_full_report.pdf)

Sustainable Transportation Strategies. *EV Charging for Persons with Disabilities*. February 2012. Available at <http://www.vacleancities.org/wp-content/uploads/EV-Charging-ADA-Version-1.0s.pdf>

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## ELECTRIC UTILITY POLICY

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- Maryland Code §7–211. Public Utilities Article. Available at [http://mlis.state.md.us/asp/web\\_statutes.asp?gpu&7-211](http://mlis.state.md.us/asp/web_statutes.asp?gpu&7-211)
- Maryland House Bill 1279, 2012. Motor Vehicle Administration—Plug-In Vehicles—Disclosure of Personal Information. Available at <http://mlis.state.md.us/2012rs/billfile/hb1279.htm>
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- Maryland Senate Bill 1279, 2012. Motor Vehicle Administration—Plug-In Vehicles—Disclosure of Personal Information. Available at <http://mlis.state.md.us/2012rs/billfile/sb0998.htm>
- Maryland Senate Bill 179, 2011. Electric Companies—Pilot Program for Charging Electric Vehicles. Available at <http://mlis.state.md.us/2011rs/billfile/sb0179.htm>
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- Virginia Clean Cities. *Virginia Get Ready: Initial Electric Vehicle Plan*. October 13, 2010. Available at <http://www.virginiaev.org/wp-content/uploads/2010/11/EV-VGR-FINAL-October-13-2010.pdf>
- Virginia Code §56-232.2:1. Regulation of Electric Vehicle Charging Service. Available at <http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+56-232.2C1>
- Virginia Code §56-1.2:1. Retail Sale of Electricity in Connection with the Provision of Electric Vehicle Charging Service. Available at <http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+56-1.2C1>

## **BEST PRACTICES**

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Public Utilities Commission of the State of California. *Alternative-Fueled Vehicle Information*. Available at [http://www.cpuc.ca.gov/PUC/hottopics/1Energy/090814\\_ev.htm](http://www.cpuc.ca.gov/PUC/hottopics/1Energy/090814_ev.htm)

Public Utilities Commission of the State of California. Rulemaking 09-08-009, Proposed Decision of Commissioner Ryan. May 21, 2010. Available at <http://docs.cpuc.ca.gov/efile/PD/118345.pdf>

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Public Utilities Commission of the State of California. Rulemaking 09-08-009, Administrative Law Judge's Ruling—Phase 3. Available at <http://docs.cpuc.ca.gov/efile/RULINGS/158505.pdf>

### **California—Joint Investor Owned Utility Assessment Report for Plug-in Electric Vehicle Notification**

Public Utilities Commission of the State of California. Rulemaking 09-08-009, Joint IOU Assessment Report for PEV Notification. Available at <http://docs.cpuc.ca.gov/efile/REPORT/156710.pdf>

### **Austin Energy—"Plug in EVerywhere" Initiative**

Austin Energy. *Charge on the Road with Plug-In EVerywhere*. 2012. Available at <http://www.austinenergy.com/about%20us/environmental%20initiatives/Plug-In%20Partners/chargeOnTheRoad.htm>

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eVgo. *NRG Launches Nation's First Privately Funded, Comprehensive Electric Vehicle Charging Ecosystem* [press release]. November 18, 2010. Available at [https://www.evgonetwork.com/News\\_and\\_Events/News\\_Archive/NRG\\_Launches\\_Nations\\_First\\_Privately\\_Funded\\_Comprehensive\\_Electric\\_Vehicle\\_Charging\\_Ecosystem/](https://www.evgonetwork.com/News_and_Events/News_Archive/NRG_Launches_Nations_First_Privately_Funded_Comprehensive_Electric_Vehicle_Charging_Ecosystem/)

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[http://www.afdc.energy.gov/afdc/vehicles/electric\\_basics\\_hev.html](http://www.afdc.energy.gov/afdc/vehicles/electric_basics_hev.html)

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[http://www.afdc.energy.gov/afdc/vehicles/search/light/autos/compare?c\[\]=10420&c\[\]=10303&c\[\]=10304&c\[\]=10357&c\[\]=10371&c\[\]=10375&c\[\]=10378&c\[\]=10386&c\[\]=10389&commit=Side-by-Side+Comparison](http://www.afdc.energy.gov/afdc/vehicles/search/light/autos/compare?c[]=10420&c[]=10303&c[]=10304&c[]=10357&c[]=10371&c[]=10375&c[]=10378&c[]=10386&c[]=10389&commit=Side-by-Side+Comparison)

U.S. Department of Transportation Federal Highway Administration. *Our Nation's Highways 2008* (Figure 4-5. Percent of Trips and Vehicle Miles by Trip Length). Available at

[http://www.fhwa.dot.gov/policyinformation/pubs/pl08021/fig4\\_5.cfm](http://www.fhwa.dot.gov/policyinformation/pubs/pl08021/fig4_5.cfm)

BMW ActiveE

<http://www.bmwusa.com/ActiveE>

Photo: <http://www.bmwusa.com/ActiveE>

Coda Automotive

<http://www.codaautomotive.com/>

Photo: <http://inhabitat.com/will-codas-upstart-electric-car-outperform-the-nissan-leaf/>

Chevrolet Volt

<http://www.chevrolet.com/volt-electric-car/>

Photo: <http://www.chevrolet.com/volt-electric-car/>

Fisker Karma

<http://www.fiskerautomotive.com/en-us>

Photo: <http://www.fiskerautomotive.com/en-us>

Ford Focus

<http://www.ford.com/electric/focuselectric/2012/>

Photo: <http://www.conceivablytech.com/5030/products/ford-unveils-focus-electric>

Honda Fit EV

<http://automobiles.honda.com/fit/>

Photo: <http://www.topspeed.com/cars/honda/2011-honda-fit-ev-concept-ar100347.html>

Mitsubishi i

<http://i.mitsubishicars.com/>

Photo: <http://evworld.com/news.cfm?newsid=19244>

Nissan LEAF

<http://www.nissanusa.com/leaf-electric-car/>

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Prius Plug In

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Smart Fortwo Electric Drive

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Photo: [http://www.auto-types.com/images/\\_autonews/2010-Smart\\_ForTwo\\_Electric\\_Drive\\_15.jpg](http://www.auto-types.com/images/_autonews/2010-Smart_ForTwo_Electric_Drive_15.jpg)

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Tesla Roadster

<http://www.teslamotors.com/roadster/>

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Toyota RAV4 EV

<http://www.toyota.com/concept-vehicles/rav4ev.html>

Photo: <http://www.toyota.com/concept-vehicles/rav4ev.html>

Wheego LiFe

<http://wheego.net/>

Photo: <http://www.thedailygreen.com/environmental-news/latest/wheego-life-electric-car#fbIndex5>

Electric car sales, as of April 2012

<http://www.csmonitor.com/Business/In-Gear/2012/0501/Electric-car-sales-fall-in-April>

Top Electric Cars 2010

<http://www.cleanfleetreport.com/top-electric-cars-2010/>

J1772 Connector

Photo: <http://www.ittcannon.com/NewProduct.aspx?id=3802>

CHAdeMO Connector

Photo: <http://evworld.com/news.cfm?newsid=26062>

Combined Charging System

Photo:

[http://media.gm.com/media/us/en/gm/news.detail.html/content/Pages/news/us/en/2012/May/0503\\_combocharging.html](http://media.gm.com/media/us/en/gm/news.detail.html/content/Pages/news/us/en/2012/May/0503_combocharging.html)

## EV CHARGING STATION INVENTORY

The following sites offer information on available EVSE:

AFDC—<http://www.afdc.energy.gov/afdc/locator/stations/?fuels=ELEC>

- Mile radius and number of stations in the radius
- Name, address, and phone number
- Filter by public and private; does not include home
- Filter by state
- Map a route
- Slated to become the national clearinghouse for EVSE location information
- GeoEVSE Forum, a public-private partnership

Clean Technica—<http://alternative-fuel.cleantechnica.com/d/a/Electric>

- A database of searchable and comparable EV stations (no map)

Coulomb ChargePoint America—<http://chargepointamerica.com/charging-find-stations.php>

ECOtality BLINK—<http://blinknetwork.com/locator.html>

Go Electric Drive—

<http://www.goelectricdrive.com/Charging/ChargingStationLocator.aspx#.TwN65Qa1ezY.email>

- Uses AFDC data

Google Maps—[maps.google.com](http://maps.google.com)

- Is another product of DOE's GeoEVSE forum
- Uses AFDC data
- Search for EV charging station near Washington, DC, on Google maps

Plug share—<http://www.plugshare.com/>

- iPhone and Android app
- Home and public
- Anyone can add a location
- Name, address, and sometimes phone number
- Type and availability
- Google map base

SemaConnect's SemaCharge—<http://www.semacharge.com/publicstations.php>



## SITING

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- Snohomish County Planning and Development Services. *Snohomish County Electric Vehicle Infrastructure Requirements*. Available at <http://www.mwcog.org/uploads/committee-documents/kV1eWlpe20120228145939.pdf>
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- The EV Project website: <http://www.theevproject.com/index.php>
- U.S. Department of Energy’s Vehicle Technologies Program. *Clean Cities Webinar—Charging Infrastructure Process Infrastructure Micro Climate Process and Data Collection*. Available at [http://www1.eere.energy.gov/cleancities/toolbox/pdfs/ev\\_charging\\_infrastructure.pdf](http://www1.eere.energy.gov/cleancities/toolbox/pdfs/ev_charging_infrastructure.pdf)

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## OUTREACH AND EDUCATION

### National Resources

- [www.goelectricdrive.com](http://www.goelectricdrive.com) is sponsored by the [Electric Drive Transportation Association](#). Also, see their [Facebook Page](#), [Twitter Feed](#), and [YouTube Page](#).
- [www.plugincars.com](http://www.plugincars.com) features an Online User's Guide for Plug-in Hybrids and Electric Cars. Also, see [their Facebook Page](#) or [Twitter Feed](#).
- [DOE Alternative Fuel Data Center](#) includes
  - [Hybrid and plug-in basics](#), benefits, maintenance comparison, and charging at home
  - The [National Alternative Fuel Station Locator](#), which includes EV charging station locations, the ability to map your route and identify stations along the way and a feature in which you can submit information to get your station added to the map.
- [Environmental Protection Agency Electric Vehicles Brochure](#)
- The EV Project [FAQs](#)
- [Clean Cities Publications](#), which include PEV handbooks for consumers, electrical contractors, fleet managers, and public charging station hosts.

### Regional Resources

- [Baltimore-Washington Electric Vehicle Initiative](#)
- [Electric Vehicle Association of Greater Washington DC](#)
- [Maryland Science Center Energy Efficient Car Exhibit](#)
- Dominion Helping You Get Plug-In Ready [brochure](#) or [web link](#)
- Pepco Electric Vehicle [Charging Information](#) and [How to Prepare](#) (for ownership)
- [BGE Plug-In Electric Vehicle Guide and Tips](#)
- Greater Washington Region Clean Cities Coalition [About Electric Vehicles](#) and [Electric Vehicle Facts](#)
- [Virginia Clean Cities Online Educational Resource](#)
- [Local events for National Alternative Fuel Vehicle Day, October 18, 2012](#)
- Georgetown Climate Center Transportation and Climate Initiative [Electric Vehicle Support Pledge](#)
- Center for Climate and Energy Solutions (C2ES) education strategies for electric vehicles— in development

## APPENDIX D

### OVERVIEW OF ELECTRIC VEHICLE PRODUCT OFFERINGS

#### CURRENTLY AVAILABLE EV AND PHEV MODELS

The most popular light duty EVs currently available in the United States—the Nissan LEAF EV and the Chevy Volt PHEV—both entered the market in December 2010. As of May 2012, nearly 12,000 LEAFs and more than 13,000 Volts had been sold nationwide. The Toyota Prius Plug-in Hybrid entered select markets in February 2012, with about 2,500 sold in the first three months of availability. The Prius PHEV is expected to be released nationally in 2013. The Fisker Karma PHEV provides an EV option in the luxury car category. Details and photos of models available in the DC market are presented below.

#### Nissan LEAF

**Fuel:** electric (dedicated)

**Class:** sedan/wagon

**Estimated Range:** 72 miles per charge

**Battery:** li-ion

**Emission Certification:** California ZEV, Tier 2

Bin 1

**Engine:** 80 kW e-motor

**Availability:** nationwide



#### Chevrolet Volt

**Fuel:** plug-in hybrid electric (hybrid electric)

**Class:** sedan/wagon

**Fuel Economy:** 95 MPGe city, 93 MPGe highway

**Estimated Electric Range:** 35 miles per charge

**Battery:** li-ion

**Emission Certification:** SULEV

**Engine:** 4-cyl, 1.4L , 111 kW e-motor

**Availability:** nationwide



#### Toyota Prius Plug-in Hybrid

**Fuel:** plug-in hybrid electric (hybrid electric)

**Class:** sedan/wagon



**Fuel Economy:** 87 MPGe city  
**Estimated Electric Range:** 15 miles per charge  
**Battery:** li-ion  
**Emission Certification:** California AT PZEV, Tier 2 Bin 3  
**Engine:** 4-cyl, 1.8L, 60 kW e-motor  
**Availability:** Select states, including Maryland and Virginia

### **Fisker Karma**

**Fuel:** plug-in hybrid  
**Class:** luxury  
**Estimated Range:** up to 50 miles of electric-only range per charge  
**Battery:** li-ion  
**Availability:** at retailers in select states nationwide, with dealerships in Greenbelt, Maryland, and Fairfax, Virginia



### **LIMITED-RELEASE AND UPCOMING MODELS**

New and upcoming entries to the EV market include the Mitsubishi “i,” the all-electric subcompact that the EPA recently named the most fuel-efficient vehicle sold in the United States. This vehicle is available for test drives and can be ordered online; it will be released nationally in the summer of 2012. Ford’s Focus EV and Honda’s Fit EV, to be released nationally in 2013, and Toyota’s RAV4 EV, expected to enter production in 2012, will round out the offering from major manufacturers. New entrants into the automotive market include the Smart Fortwo Electric Drive, the Wheego LiFe, and the Coda Automotive CODA.

A number of luxury EV models are beginning to emerge. The Tesla Roadster was the first highway-capable EV in serial production available in the United States. It first became available in 2009, but its American models have sold out and will not be rereleased until at least 2013. The manufacturer’s next offering, the Model S, will have one of the longest electric-only ranges of EVs on the market. The BMW ActiveE is in demonstration phase, with 700 vehicles available for lease in select markets. Details and photos of these models are presented below.

### **Mitsubishi i**

**Fuel:** electric (dedicated)  
**Class:** subcompact



**Estimated Range:** 100 miles city/56 average miles per charge

**Battery:** li-ion

**Emission Certification:** California ZEV, Tier 2 Bin 1

**Engine:** 66 kW e-motor

**Availability:** available for test drives and online orders; nationwide release in summer 2012

### **Ford Focus EV**

**Fuel:** electric (dedicated)

**Class:** sedan/wagon

**Estimated Range:** 100 miles per charge

**Battery:** li-ion

**Emission Certification:** Tier 2 Bin 1, ZEV

**Engine:** 105 kW e-motor

**Availability:** California, New York, New Jersey



### **Honda Fit EV**

**Fuel:** electric (dedicated)

**Class:** two-seater

**Estimated Range:** 100 miles per charge

**Battery:** li-ion

**Emission Certification:** California ZEV, Tier 2 Bin 1

**Transmission:** 3 mode/1 speed

**Availability:** leases available to approximately 1,100 customers in California and Oregon in summer 2012, extending to select East Coast markets in 2013



### **Smart Fortwo Electric Drive**

**Fuel:** electric (dedicated)

**Class:** subcompact

**Estimated Range:** 98 miles city/63 average miles per charge

**Battery:** li-ion

**Availability:** 250 vehicles available for lease in select U.S. markets; full-scale production to begin in 2012



### **Toyota RAV4 EV**

**Fuel:** electric (dedicated)

**Class:** subcompact

**Estimated Range:** 100 miles per charge expected

**Battery:** unknown

**Availability:** currently in demonstration phase; expected to enter production in 2012



### **Wheego LiFe (2012)**

**Fuel:** electric (dedicated)

**Class:** two-seater

**Estimated Range:** 100 miles per charge

**Emission Certification:** California ZEV, Tier 2 Bin 1

**Engine:** 15 kW e-motor

**Availability:** select states; dealerships in Columbia, Maryland, and Fairfax, Virginia



### **Coda Automotive CODA (2012)**

**Fuel:** electric (dedicated)

**Class:** sedan/wagon

**Estimated Range:** 150 miles per charge

**Battery:** LiFePO4

**Emission Certification:** Tier 2 Bin 1, ZEV

**Engine:** 100kW e-motor

**Availability:** California



### **Tesla Roadster**

**Fuel:** electric (dedicated)

**Class:** luxury subcompact

**Estimated Range:** 245 miles per charge

**Battery:** li-ion

**Engine:** 375-volt AC induction air-cooled electric motor with variable frequency drive

**Availability:** First release has sold out; will be reintroduced in 2014



**Tesla Model S EV**

**Fuel:** electric (dedicated)

**Class:** luxury sedan

**Estimated Range:** 300 miles per charge

**Battery:** li-ion

**Emission Certification:** California ZEV, Tier 2 Bin 1

**Availability:** Limited release to the United States in mid-2012



**BMW ActiveE**

**Fuel:** electric (dedicated)

**Class:** luxury sedan

**Estimated Range:** 100 miles per charge

**Battery:** li-ion

**Availability:** 700 vehicles available for lease in 2012, not available in the metropolitan Washington region

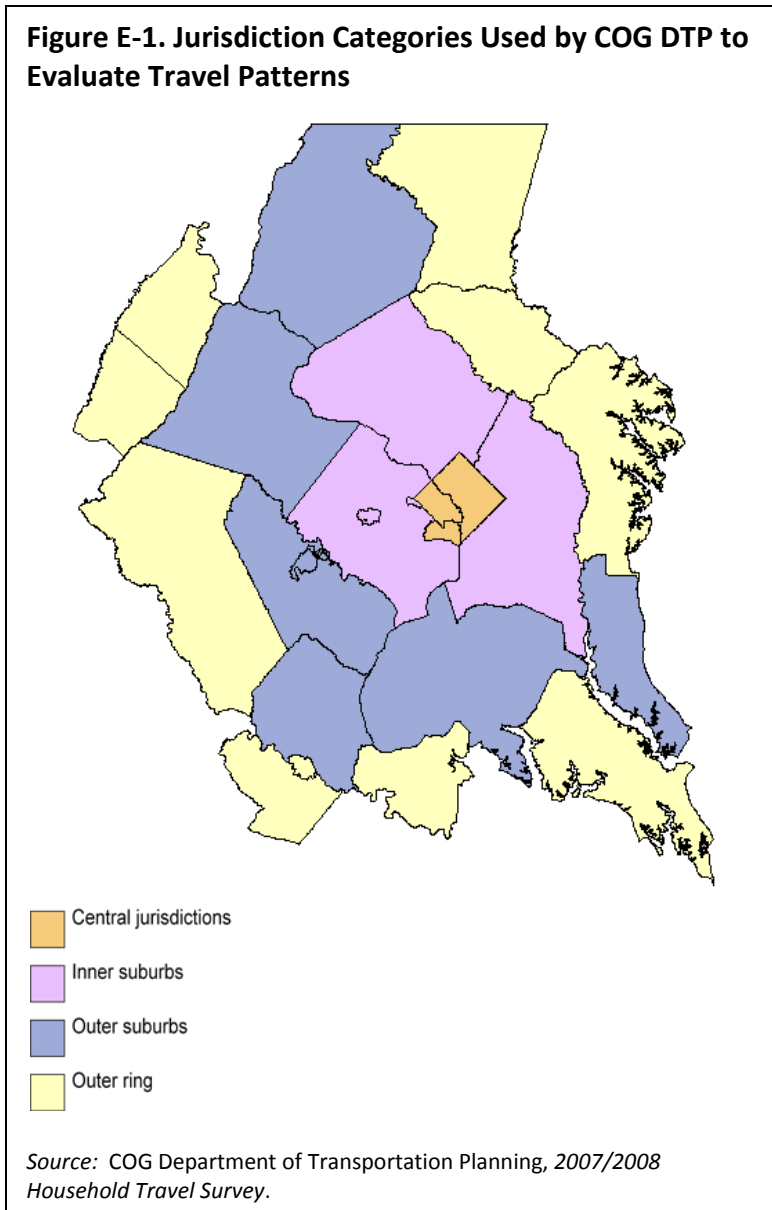


## APPENDIX E

### REGION TRAVEL PATTERNS AND HOUSEHOLD TRAVEL DEMAND

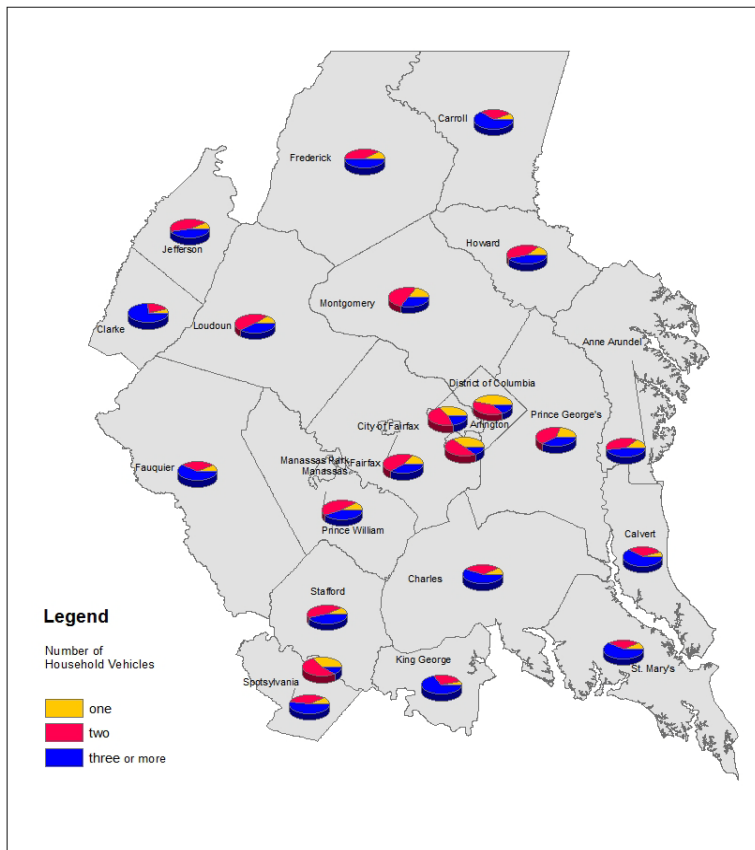
#### VEHICLES BY HOUSEHOLD

The COG Department of Transportation Planning (DTP) conducted a household travel demand survey in 2007–2008. The results are used in planning for future transportation needs. Figure E-1 shows the jurisdictional categories that DTP used when evaluating travel patterns. Figure E-2 shows vehicle ownership by household and provides some indication of the spatial distribution of potential electric vehicle (EV) demand. Due to EV range restrictions and access to private garages for home charging, EVs may be most suitable as the second car in two or more vehicle households located in suburban, car-dependent areas. Outer suburbs and exurbs may require more frequent long trips that are out of the range of EVs. Core urban areas may be served by alternative transportation and car-shared EVs and may contain more one-car or no-car households.





**Figure E-2. Number of Household Vehicles in the Metropolitan Washington Region**

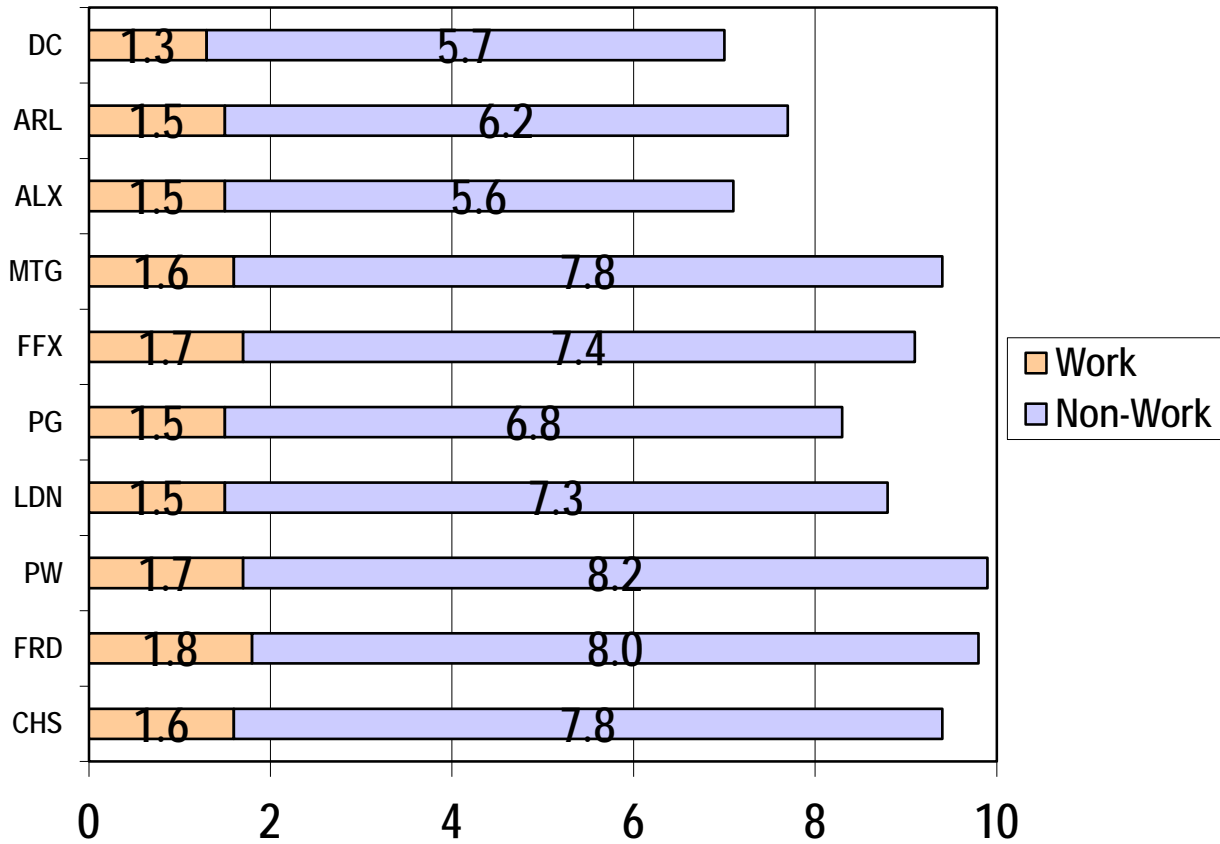


Source: COG Department of Transportation Planning, 2007/2008 Household Travel Survey.

### TRIP CHARACTERISTICS

As noted in Figure E-3, households generally take six to 10 trips per day, and most of those trips are for non-work-related purposes.<sup>72</sup>

**Figure E-3. Average Daily Trips per Household by Jurisdiction and Purpose (# of trips), Metropolitan Washington Region**



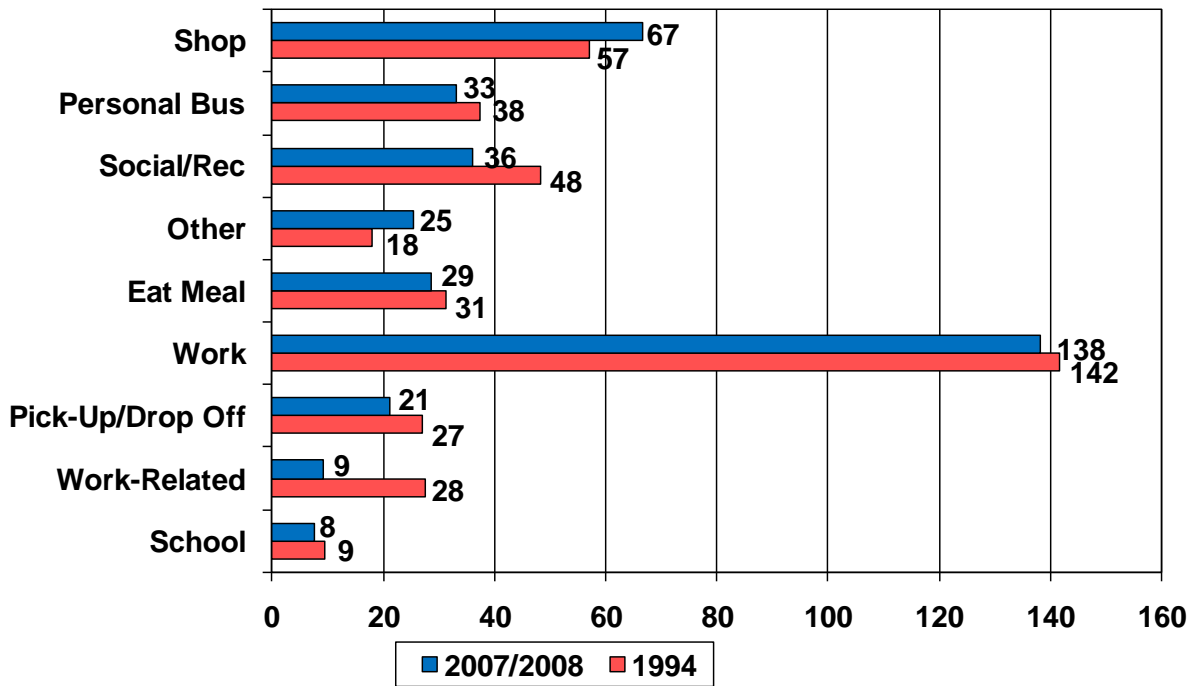
Note: DC = District of Columbia, ARL = Arlington County, ALX = City of Alexandria, MTG = Montgomery County, FFX = Fairfax County, PG = Prince George’s County, LDN = Loudoun County, PW = Prince William County, FRD = Frederick County, CHS = Charles County.

Source: COG Department of Transportation Planning, 2010

<sup>72</sup> COG Department of Transportation Planning. 2010. *Household Travel Survey for the Metropolitan Washington Region*. Presentation by Robert E. Griffiths, Technical Services Director, National Capital Region Transportation Planning Board, Metropolitan Washington Council of Governments. For the National Capital Planning Commission Meeting. April 15, 2010.

For individuals between 25 and 34 years old, most trips in the metropolitan Washington region are related to work (see Figure E-4). Shopping, personal business, and social/recreational trips are also prevalent. For senior citizens, most trips are related to shopping, personal business, and recreation.

**Figure E-4. Number of Daily Trips by Trip Purpose per 100 Persons (ages 25 to 34 years)**



Source: COG Department of Transportation Planning, 2010

The median vehicle trip in the metropolitan Washington region is less than 10 miles. Many trips are less than 2–5 miles.<sup>73</sup> Figure E-5 shows how median length of trip varies by trip purpose.

**Figure E-5. Trip Length Distribution by Purpose (distance in miles)**

<b>Purpose</b>	<b>Median Trip Length</b>
Work	9.3
To Work after Other Stop (JTW)	4.8
Work-Related	5.6
School	2.1
Social/Rec	2.9
Shop/Meal	2.1
Pick-Up	2.2
Personal Bus	3.5
Other	1.5

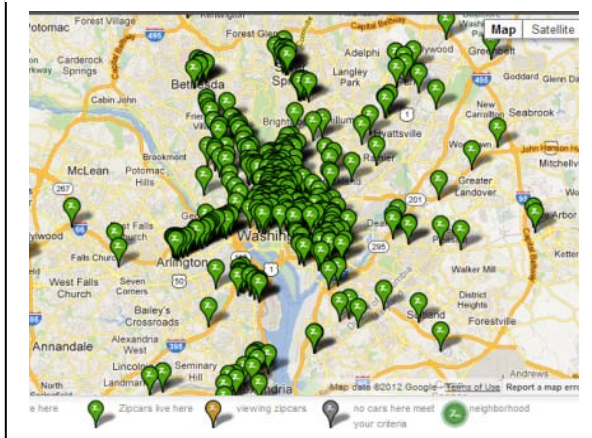
*Source: COG Department of Transportation Planning, 2010*

<sup>73</sup> COG DTP 2010. *Household Travel Survey for the Metropolitan Washington Region*. Presentation by Robert E. Griffiths, Technical Services Director, National Capital Region Transportation Planning Board, Metropolitan Washington Council of Governments. For the National Capital Planning Commission Meeting. April 15, 2010.

## APPENDIX F

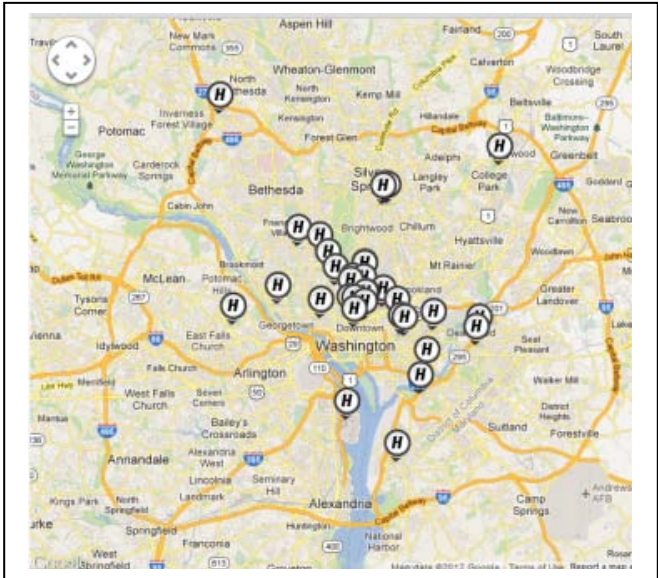
### CAR SHARING PROGRAMS IN THE NATIONAL CAPITAL REGION

Car-share parking spaces are located in various underutilized existing lots, making the most of scarce urban and suburban real estate. According to Zipcar's website, each shared car takes several personally owned vehicles off the road. Car-share electric vehicles (EVs) could help serve urban residents or those living in multifamily developments. Three companies offer car sharing in the region:



**Zipcar** has over 9,000 vehicles in the region's fleet. Zipcar has piloted EVs in other locations including California and Massachusetts. Factors influencing Zipcar's use of EVs in a given city include presence of zero emission vehicle requirements and grant funding.

**Hertz On Demand** recently launched in the metropolitan Washington region. Their network includes conventional vehicles but also offers Smart EV, Nissan LEAF, and Chevy Volt options.



**car2go** is a car-sharing network of conventional fortwos. car2go does not offer EVs at this time.

## APPENDIX G

### REGION CHARGING STATION INVENTORY

Station Name	Address	City	State	ZIP	Phone	Access	Level 1 Charger	Level 2 Charger
<b>Fashion Centre at Pentagon City</b>	1100 S Hayes St	Arlington	VA	22202	888-758-4389	Public	0	4
<b>Views at Clarendon</b>	1210 N Highland St	Arlington	VA	22201		Planned	0	2
<b>Arlington County</b>	1400 N Uhle St	Arlington	VA	22201	888-758-4389	Private	0	1
<b>1400 Joyce St</b>	1400 S Joyce St	Arlington	VA	22202	888-758-4389	Public	1	1
<b>220Living</b>	220 20th St S	Arlington	VA	22202	888-758-4389	Public	1	1
<b>Arlington Courthouse Plaza</b>	2200 Clarendon Blvd	Arlington	VA	22201	888-758-4389	Public	1	1
<b>Crystal City Plaza</b>	2200 Crystal Dr	Arlington	VA	22202	888-758-4389	Public	1	1
<b>Crystal City Shops</b>	2231 Crystal Dr	Arlington	VA	22202	888-758-4389	Public	2	3
<b>The Concord</b>	2600 Crystal Dr	Arlington	VA	22202	800-663-5633	Public	0	2
<b>Potomac Overlook Regional Park</b>	2845 N Marcey Rd	Arlington	VA	22207	800-663-5633 703-528-5406	Public	1	1
<b>Virginia Tech Research Center</b>	900 N Glebe Rd	Arlington	VA	22203	888-758-4389	Public	2	2
<b>National Airport garage B east side</b>	2400 S Smith Blvd	Arlington	VA	22202	888-758-4389	Public	4	4
<b>Potomac Yard North</b>	2733 South Crystal Drive	Arlington	VA	22202		Public	6	6
<b>Potomac Yard South</b>	2777 South Crystal Drive	Arlington	VA	22202		Planned	1	1
<b>Potomac Yard South</b>	2777 South Crystal Drive	Arlington	VA	22202		Public	6	6
<b>Skyline Shopping Center</b>	5203 Leesburg Pk	Falls Church	VA	22041	888-758-4389	Public	0	2
<b>Brown's Fairfax Nissan</b>	11000 Main St	Fairfax	VA	22030	703-591-8009	Public	0	1
<b>Nissan of Chantilly</b>	14840 Stonecroft Center C	Chantilly	VA	20151	703-889-3700	Public	0	1
<b>Passport Nissan - Alexandria</b>	150 S Pickett St	Alexandria	VA	22304	703-823-9000	Public	0	1
<b>Wolf Trap</b>	1551 Trap Rd	Alexandria	VA	22314	888-758-4389	Public	2	2
<b>The Barns at Wolf Trap</b>	1645 Trap Rd	Alexandria	VA	22314	888-758-4389	Public	1	1
<b>Carr Properties</b>	1701 Duke St	Alexandria	VA	22314	888-758-4389	Planned	1	1
<b>Carr Properties</b>	1800 Diagonal Rd	Alexandria	VA	22314	888-758-4389	Public	1	1
<b>Center for Innovative Technology Headquarters</b>	2214 Rock Hill Rd	Herndon	VA	20170	888-758-4389 703-742-6971	Public	1	1
<b>Walgreens</b>	225 Maple Ave E	Vienna	VA	22180	800-663-5633	Public	0	1
<b>Stone's Cove Kitbar</b>	2403 Centreville Rd	Herndon	VA	20171	703-434-3615	Public	0	1
<b>Halstead Square</b>	2750 Gallows Rd	Vienna	VA	22180	800-663-5633	Private	0	1

<b>Walgreens</b>	3050 Nutley St	Fairfax	VA	22031	800-663-5633	Public	0	1
<b>MOM's Market</b>	424 Elden St	Herndon	VA	20171	888-758-4389	Public	2	2
<b>Walgreens</b>	6717 Richmond Hwy	Alexandria	VA	22306	800-663-5633	Public	0	1
<b>Walgreens</b>	7629 Richmond Hwy	Alexandria	VA	22306	800-663-5633	Public	0	1
<b>Gosnell Properties</b>	8130 Boone Blvd	Vienna	VA	22182	888-758-4389	Public	2	2
<b>Gosnell Properties - Lower Parking Garage</b>	8130 Boone Blvd	Vienna	VA	22182	888-758-4389	Public	1	1
<b>Rosenthal Nissan Mazda</b>	8525 Leesburg Pike	Vienna	VA	22182	703-442-8700	Public	0	1
<b>Smart Center Tysons Corner</b>	8601 Leesburg Pike	Vienna	VA	22182	888-758-4389	Public	1	2
<b>MOM's Market</b>	Post Dr	Herndon	VA	20170	888-758-4389	Public	2	2
<b>Flint Hill</b>	3201 Jermantown Rd	Fairfax	VA	22030	703-964-0432	Private	0	1
<b>Koons Nissan</b>	1051 E Broad St	Falls Church	VA	22044	703-241-1000	Public	0	1
<b>Scott Jenkins Memorial Park - Loudoun County</b>	39464 E Colonial Hwy	Hamilton	VA	20158	888-758-4389	Public	5	5
<b>Brown's Sterling Nissan</b>	45155 Towlern Pl	Sterling	VA	20166	703-948-1100	Public	0	1
<b>Metropolitan Washington Airports Authority</b>	Cargo Dr	Sterling	VA	20166	888-758-4389	Public	4	4
<b>Atlantic Corporate Park</b>	45600 Woodland Rd	Sterling	VA	20166	703-964-0431	Private	0	1
<b>City of Manassas - Public Works</b>	8500 Public Works Dr	Manassas	VA	20110	888-758-4389	Public	0	1
<b>Sheehy Nissan of Manassas</b>	9010 Liberia Ave	Manassas	VA	20110	703-361-5161	Public	0	1
<b>City of Manassas - City Hall</b>	9027 Center St	Manassas	VA	20110	888-758-4389	Public	2	2
<b>City of Manassas - Manassas Museum</b>	9101 Prince William St	Manassas	VA	20110	888-758-4389	Public	2	2
<b>City of Manassas - Virginia Railroad Express Garage</b>	9102 Prince William St	Manassas	VA	20110	888-758-4389	Public	2	2
<b>Kohl's</b>	13651 Foulger Sq	Woodbridge	VA	22192	888-758-4389	Public	1	1
<b>Walgreens</b>	6400 Hoadly Rd	Manassas	VA	20112	888-758-4389	Public	0	1
<b>IBEW Local Union 26 - Joint Apprenticeship and Training Committee</b>	7016 Infantry Ridge Rd	Manassas	VA	20109	888-758-4389	Public	2	2
<b>Cowles Nissan</b>	14777 Jefferson Davis Hwy	Woodbridge	VA	22191	703-497-3000	Public	0	1
<b>MedImmune Ventures</b>	1 MedImmune Way	Gaithersburg	MD	20878	888-758-4389	Public	2	2
<b>MedImmune Ventures</b>	1 MedImmune Way	Gaithersburg	MD	20878	888-758-4389	Public	3	3
<b>MedImmune Ventures - Visitor's Parking Lot</b>	1 MedImmune Way	Gaithersburg	MD	20878	888-758-4389	Public	1	1
<b>MedImmune Ventures - Employee Parking Lot</b>	101 Orchard Ridge Dr	Gaithersburg	MD	20878	888-758-4389	Public	1	1
<b>Charles County Hilton</b>	10385 O'Donnell Pl	Waldorf	MD	20601	800-663-5633	Public	0	2
<b>SunTrust Bank</b>	10415 Old Georgetown Rd	Bethesda	MD	20814	800-663-5633	Public	0	3

<b>The Tower Companies - The Tower Building</b>	1101 Wootton Pkwy	Rockville	MD	20852	800-663-5633	Private	0	1
<b>Kohl's</b>	12024 Cherry Hill Rd	Silver Spring	MD	20904	888-758-4389	Public	1	1
<b>The Tower Companies - The Blairs Shopping Center</b>	1220 East West Hwy	Silver Spring	MD	20910	800-663-5633	Public	0	2
<b>Crain Memorial Welcome Center - Charles County</b>	12480 Crain Hwy	Newburg	MD	20664	888-758-4389	Planned	1	1
<b>Linganore Winecellars</b>	13601 Glissans Mill Rd	Mount Airy	MD	21771		Planned	0	1
<b>The Tower Companies - The Blairs</b>	1401 Blair Mill Rd	Silver Spring	MD	20910	800-663-5633	Public	0	1
<b>Darcars Nissan</b>	15911 Indianola Dr	Rockville	MD	20855	301-309-2200	Public	0	1
<b>Criswell Nissan</b>	19574 Amaranth Dr	Germantown	MD	20874	301-670-3900	Public	0	1
<b>The Tower Companies - Headquarters</b>	2000 Tower Oaks Blvd	Rockville	MD	20852	800-663-5633	Private	0	1
<b>Walgreens</b>	25 High St	Waldorf	MD	20602	800-663-5633	Public	0	1
<b>Olde Towne Youth Center - Gaithersburg</b>	301 Teachers Way	Gaithersburg	MD	20877	301-258-6374	Public	1	0
<b>Herb Gordon Nissan</b>	3131 Automobile Blvd	Silver Spring	MD	20904	301-890-8200	Public	0	1
<b>Charles County Public Library - Potomac Branch</b>	3225 Ruth B Swann Dr	Indian Head	MD	20640	888-758-4389	Public	1	1
<b>University of Maryland-College Park - Lot U4</b>	4116-4138 Mowatt Ln	College Park	MD	20740	888-758-4389	Public	1	1
<b>Indian Head Town Hall</b>	4195 Indian Head Hwy	Indian Head	MD	20640	888-758-4389	Public	1	1
<b>Joint Apprenticeship and Training Committee - IBEW Local Union 26</b>	4371 Parliament Pl	Lanham-Seabrook	MD	20706	888-758-4389	Public	3	3
<b>The Prime Street Grille</b>	4680 Crain Hwy	White Plains	MD	20695	888-758-4389	Public	2	2
<b>Charles County Public Library - PD Brown Memorial Branch</b>	50 Village St	Waldorf	MD	20602	888-758-4389	Public	1	1
<b>Passport Nissan Marlow Heights</b>	5000 Auth Way	Marlow Heights	MD	20746	301-423-8400	Public	0	1
<b>Walgreens</b>	6300 Crain Hwy	La Plata	MD	21646	800-663-5633	Public	0	1
<b>Frederick Nissan</b>	7418 Grove Rd	Frederick	MD	21704	301-662-0111	Public	0	1
<b>Chevy Chase Nissan</b>	7701 Wisconsin Ave	Bethesda	MD	20814	301-656-9200	Public	0	1
<b>Mona Electric Group</b>	7915 Malcolm Rd	Clinton	MD	20735	888-758-4389	Public	1	1
<b>Frederick Community College</b>	7932 Opossumtown Pike	Frederick	MD	21702	800-663-5633	Public	0	2
<b>Hawkins Electric</b>	8001 Sheriff Rd	Landover	MD	20785	888-758-4389	Planned	1	1
<b>King Farm</b>	805 King Farm Blvd	Rockville	MD	20850	800-663-5633	Planned	0	2
<b>University of Maryland - Shady Grove</b>	9630 Gudelsky Dr	Rockville	MD	20850	888-758-4389	Public	0	1



<b>MOM's Organic Market - College Park</b>	9827 Rhode Island Ave	College Park	MD	20740	301-220-1100 888-758-4389	Public	2	2
<b>University of Maryland- College Park - Union Lane</b>	Library Ln	College Park	MD	20740	888-758-4389	Public	2	2
<b>University of Maryland- College Park - Lot EE</b>	Paint Branch Dr	College Park	MD	20740	888-758-4389	Public	1	1
<b>University of Maryland - College Park - Regents Dr</b>	Regents Dr	College Park	MD	20740	888-758-4389	Public	2	2
<b>University of Maryland- College Park - Stadium Garage</b>	Stadium Dr	College Park	MD	20740	888-758-4389	Public	1	1
<b>Bethesda Row Garage</b>	4950 Elm St	Bethesda	MD	0	305-521-0200	Public	1	0
<b>Town Square</b>	200 E Middle Lane	Rockville	MD	0	240-403-1141	Public	1	0
<b>Indian Head Naval Base BVSE Bldg 525</b>	4145 Lloyd Road	Indian Head	MD	20640		Public	0	1
<b>Sheehy Nissan of Waldorf</b>	2950 Crain Hwy	Waldorf	MD	20601	301-843-5300	Public	0	2
<b>Bowie Nissan</b>	2200 Crain Highway	Bowie	MD	20716	301-218-3100	Public	0	3
<b>FedEx Field</b>	1600 FedEx Way	Landover	MD	20785		Planned	4	4
<b>Darcars Nissan of College Park</b>	9330 Baltimore Ave	College Park	MD	20740	301-459-6800	Public	0	1
<b>NIH Fishers Lane Conference Center</b>	5635 Fishers Lane	Rockville	MD	0		Public	0	2
<b>Lenkin Co</b>	1050 K St NW	Washington	DC	20001	888-758-4389	Public	2	2
<b>Manulife Building</b>	1100 New York Ave NW	Washington	DC	20004	202-289-6820	Public	1	1
<b>Lenkin Co</b>	1133 Connecticut Ave NW	Washington	DC	20036	888-758-4389	Public	2	2
<b>Carr Properties</b>	1255 23rd St NW	Washington	DC	20037	888-758-4389	Public	1	1
<b>Lenkin Co</b>	1300 19th St NW	Washington	DC	20036	888-758-4389	Planned	2	2
<b>CoStar Group</b>	1331 L St NW	Washington	DC	20005	888-758-4389	Public	0	1
<b>Carr Properties</b>	1455 Pennsylvania Ave NW	Washington	DC	20004	888-758-4389	Public	1	1
<b>Carr Properties</b>	1575 I St NW	Washington	DC	20005	888-758-4389	Public	1	1
<b>The Tower Companies</b>	1707 L St NW	Washington	DC	20036	888-758-4389	Public	1	1
<b>The Tower Companies</b>	1828 L St NW	Washington	DC	20036	888-758-4389	Public	1	1
<b>Manulife Building</b>	1850 M St NW	Washington	DC	20036	877-308-7714	Public	1	1
<b>The Tower Companies - Millennium Building</b>	1909 K St NW	Washington	DC	20006	888-758-4389	Public	2	2
<b>District Department of Transportation - Franklin D Reeves Center</b>	2000 14th St NW	Washington	DC	20009	888-758-4389	Public	2	2
<b>Washington Real Estate Investment Trust (WRIT)</b>	2000 M St	Washington	DC	20036	800-663-5633	Public	0	2
<b>Control Data Learning</b>	2101 L St NW	Washington	DC	20037	888-758-4389	Public	1	1

<b>Center</b>								
<b>Lenkin Company</b>	2201 Wisconsin Ave NW	Washington	DC	21401	800-663-5633	Public	0	2
<b>Carr Properties</b>	2233 Wisconsin Ave NW	Washington	DC	20007	888-758-4389	Public	1	1
<b>Car Charging Group Inc - Union Station Garage L1</b>	300 Massachusetts Ave NE	Washington	DC	20002	888-758-4389	Public	1	1
<b>Car Charging Group Inc - Union Station Garage L2</b>	300 Massachusetts Ave NE	Washington	DC	20002	888-758-4389	Public	1	1
<b>Washington Harbour Shopping Plaza</b>	3000 K St NW	Washington	DC	20007	888-758-4389	Public	2	2
<b>M Street Garage</b>	3307 M St	Washington	DC	20007	800-663-5633	Public	0	1
<b>Lexington/Market Square Parking Garage</b>	401 9th St NW	Washington	DC	20004	800-663-5633	Public	0	1
<b>Days Inn</b>	4400 Connecticut Ave NW	Washington	DC	20008	800-663-5633	Planned	0	2
<b>American University - Katzen Arts Center</b>	4400 Massachusetts Ave NW	Washington	DC	20016	888-758-4389	Public	1	1
<b>Donohoe Re Services</b>	550 C St SW	Washington	DC	20024	888-758-4389	Public	0	2
<b>Manulife Building</b>	555 12th St NW	Washington	DC	20004	202-624-0841	Public	1	1
<b>Columbia Square Underground Parking Garage</b>	555 13th St NW	Washington	DC	20005	888-758-4389	Public	2	2
<b>Hogan Lovells</b>	555 13th St NW	Washington	DC	20005	888-758-4389	Private	1	1
<b>National Public Radio</b>	635 Massachusetts Ave NW	Washington	DC	20001	888-758-4389	Private	3	3
<b>Victor Building Parking Garage</b>	750 9th St NW	Washington	DC	20001	202-638-0253	Public	1	1
<b>George Washington University</b>	801 22nd St NW	Washington	DC	20050	888-758-4389	Public	1	1
<b>Carr Properties</b>	901 K St NW	Washington	DC	20001	888-758-4389	Public	1	1
<b>Equity Residential</b>	425 Massachusetts Ave NW	Washington	DC	20001		Private	1	1
<b>Florida Power &amp; Light</b>	801 Pennsylvania Ave NW	Washington	DC	20004	202-347-7082	Private	0	1
<b>Blue Plains Wastewater Treatment Plant</b>	5000 Overlook Ave. SW	Washington	DC	20032		Private	0	2
<b>Main &amp; O Pumping Stations</b>	125 O St SE	Washington	DC	20003		Private	1	0
<b>Firstfield Shopping Center</b>	505 Quince Orchard Rd	Gaithersburg	MD	20878	703-442-4331	Public	0	2

*Note:* Includes stations published on AFDC, Plugshare, and other sources as of late April/early May 2012. Does not include single family home installations.

## APPENDIX H

### LOCAL GOVERNMENT EV READINESS

To begin understanding the current landscape of electric vehicle (EV) development in the metropolitan Washington region, in January 2012 COG conducted a survey of its member jurisdictions. The survey questions are listed below:

#### COG EV SURVEY QUESTIONS

1. *Do you track electric vehicle charging permit applications? If yes, please provide the total number of applications submitted.*
2. *How many total electric vehicle charging stations are currently permitted in your jurisdiction?*
  - *Privately owned residential?*
  - *Commercial (retail, offices, etc.)?*
  - *Public (on-street or publically owned lots or garages)?*
3. *Describe your jurisdiction's electric vehicle permitting process for residential, commercial, and public charging.*
  - *Apply in-person or online?*
  - *What is the turnaround time?*
  - *What is the cost?*
4. *How long does the inspection process take after a charging station is installed (from scheduling to completion)?*
  - *Privately owned residential?*
  - *Commercial (retail, offices, etc.)?*
  - *Public (on-street or publically owned lots or garages)?*
5. *Has your jurisdiction developed policies related to electric vehicle or electric vehicle charging station deployment? If yes, please describe for each of the following and provide a web link to the policy.*
  - *Building code policy*
  - *Comprehensive planning*
  - *Restrictions on EV parking spaces, ADA restrictions, etc.*
  - *Green building or LEED considerations*
  - *Zoning and/or land use planning*

6. *Does your jurisdiction offer incentives, such as preferred parking, for electric vehicles? Describe the incentives.*

## **OVERVIEW OF RESULTS**

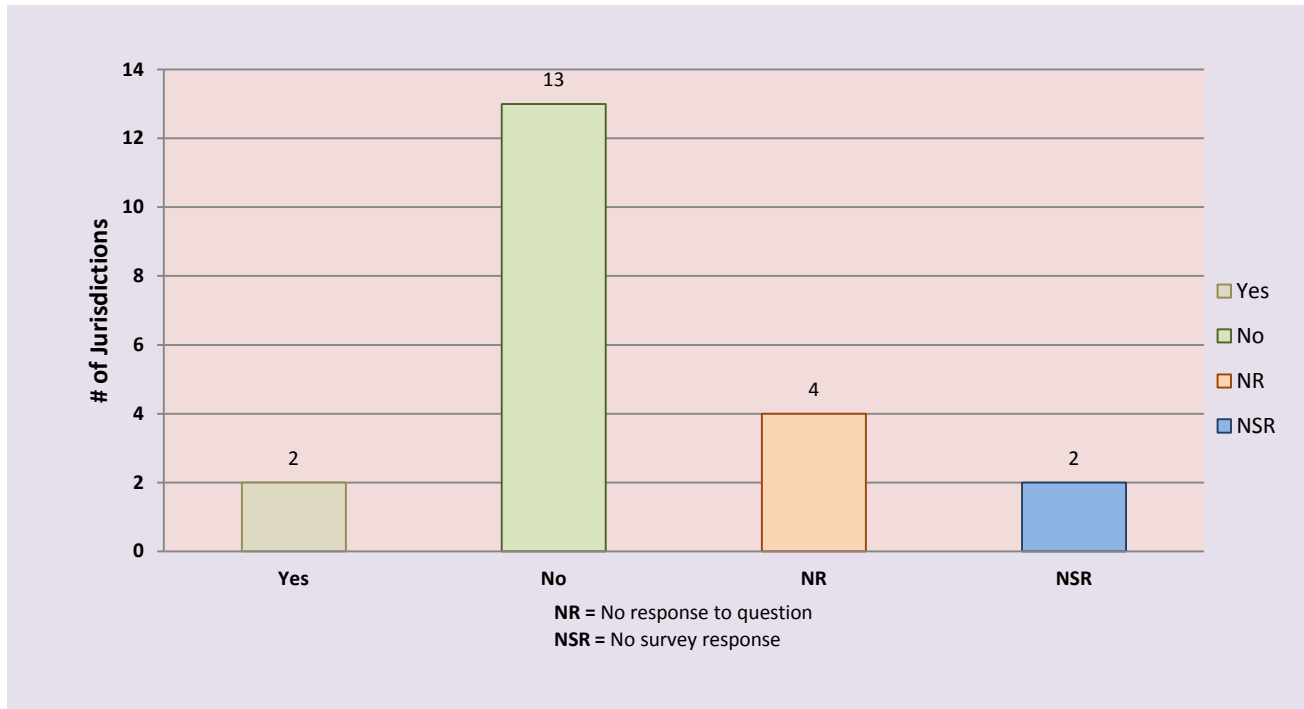
Of the 21 jurisdictions surveyed, 15 responded. Two jurisdictions reported tracking EV permitting applications, and three reported collecting and compiling permitting and inspection data. In all, 51 permitted charging stations were reported.

### **Permitting and Inspection Processes**

Figure H-1 and Tables H-1–H-4 provide a detailed look at the current status of the permitting and inspection processes in the region. The City of Frederick, Maryland, and Falls Church, Virginia, are currently tracking EV charging permit applications. The District of Columbia; Montgomery County, Maryland; Takoma Park, Maryland; Rockville, Maryland; Gaithersburg, Maryland; Bowie, Maryland; College Park, Maryland; Greenbelt, Maryland; Arlington County, Virginia; Fairfax County, Virginia; the City of Fairfax, Virginia; Prince William County, Virginia; and Manassas, Virginia, are not tracking EV charging permit applications. The remaining jurisdictions did not respond to the question.

It is important to note that most jurisdictions consider EV charging infrastructure to be a standard electric appliance for Level 1 (120V, 15 amps, single phase) or Level 2 (208/240V, 30 amps, single phase) charging.

**Figure H-1: Permit Tracking**



**Table H-1  
Types of Permitting**

Types of permitting	Residential	Commercial	Public
Online	DC, Fairfax Co.	DC, Fairfax Co.	DC
Paper			Fairfax Co.
Other	Falls Church	Falls Church	Falls Church

**Table H-2  
Permit Turnaround Time**

Permitting Turnaround Time	Residential	Commercial	Public
24-48 hrs	DC, Fairfax Co.	DC, Fairfax Co.	DC
More than 7 days	Falls Church	Falls Church	Falls Church, Fairfax County

**Table H-3**  
**Permit Costs**

Permitting Costs	Residential	Commercial	Public
Btwn \$10-\$50	Falls Church	Falls Church	Falls Church
Btwn \$51-\$100	Fairfax Co.	Fairfax Co.	NR
Variable	DC	DC	DC

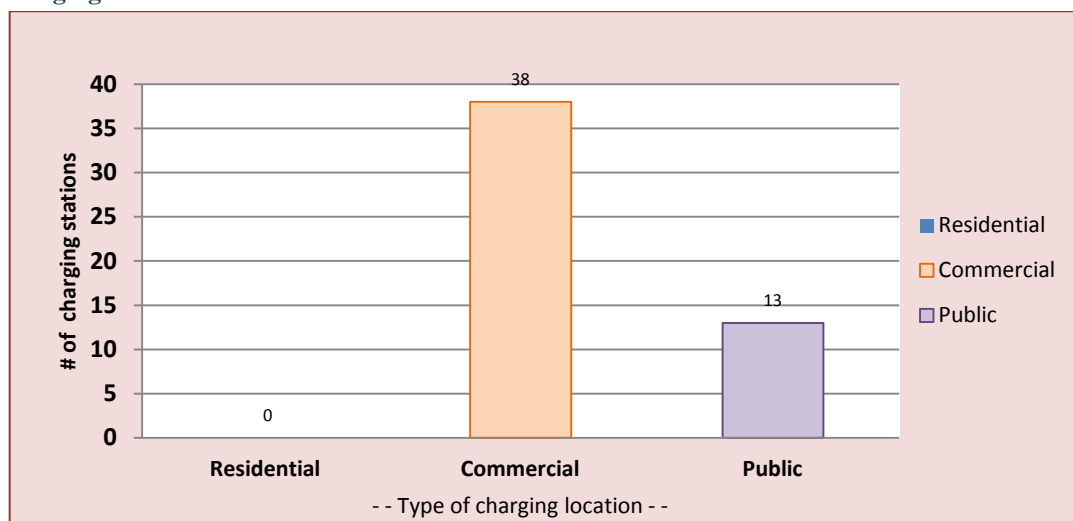
**Table H-4**  
**Inspection Turnaround Time**

Inspection Turnaround Time	Residential	Commercial	Public
24-48 hrs	Falls Church, Fairfax	Falls Church, Fairfax	Falls Church, Fairfax
Btwn 3-7 days	DC	DC	DC

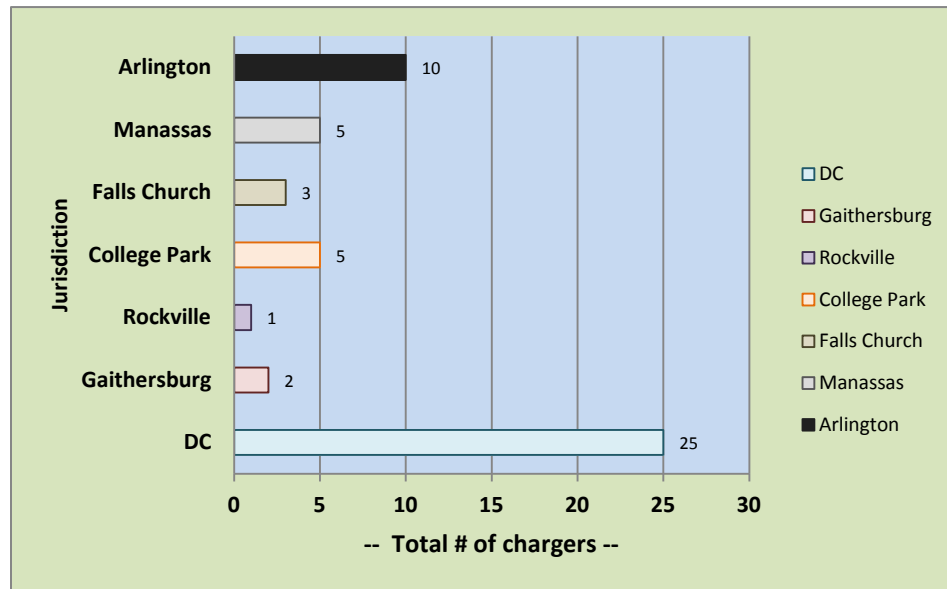
### Charging Infrastructure

Adequate infrastructure is essential to addressing the range anxiety that many potential EV drivers might have. Figure H-2 indicates that local governments reported only 51 commercial and public EV charging stations in the region. Figure H-3 gives a jurisdictional breakdown of those charging stations.

**Figure H-2**  
**Permitted Charging Stations**



**Figure H-3**  
**Number of Charging Stations by Jurisdiction**



**Electric Vehicle Policy Development**

Most jurisdictions have no EV policy development in place. EV policies might include comprehensive plan language for new or redevelopment projects or zoning and land use language for existing development. The District of Columbia and Fairfax County, Virginia, currently have zoning considerations during the permit review process and building code policy and ADA parking restrictions for EV infrastructure development.

The District of Columbia; City of Frederick, Maryland; Bowie, Maryland; Fairfax County, Virginia; and Manassas, Virginia, offer the following incentives for EVs:

- dedicated on-street public charging near building entrances,
- preferred parking in public parking decks,
- preferred parking for fuel efficient vehicles at government buildings, and
- preferred parking at some LEED (Leadership in Energy and Environmental Design) buildings.

Montgomery County, Maryland; Takoma Park, Maryland; College Park, Maryland; Gaithersburg, Maryland; Rockville, Maryland; Arlington County, Virginia; Falls Church, Virginia; and Prince William County, Virginia do not offer EV incentives at this time.

## APPENDIX I

### APPLICABLE EV INCENTIVES, LAWS, AND REGULATIONS

#### FEDERAL INCENTIVES

##### Vehicle Tax Credit for Cars

Purchasers of electric vehicles (EVs) and plug-in hybrid electric vehicles (PHEVs) with a gross vehicle weight rating (GVWR) of up to 14,000 lbs. that meet specified emission standards receive a tax credit of \$2,500 to \$7,500, depending on size of battery (4–16 kWh). This tax credit applies to vehicles sold after December 31, 2009. It will begin to be phased out for each manufacturer in the second quarter following the calendar quarter in which a minimum of 200,000 qualified plug-in electric drive vehicles have been sold by that manufacturer for use in the United States (see the Internal Revenue Service [Plug-In Electric Vehicle Credit](#) website).<sup>74</sup>

##### Expired Federal Incentives (as of December 31, 2011)

*Two- or Three-Wheelers.* Two- or three-wheeled vehicles with a minimum of 2.5 kWh of batteries were eligible for a 10 percent consumer tax credit (up to a maximum of \$2,500 tax credit on vehicles costing \$25,000 or more). Efforts are underway to renew this credit.

*Conversions.* Both PHEV conversions and conversions from combustion engines to EVs were eligible for a 10 percent tax credit with a maximum credit of \$4,000 (on a \$40,000 conversion expense). Efforts are underway to renew this credit.

*Charging Stations.* EV charging equipment installed before the end of 2011 were eligible for a tax credit for 30 percent up to \$1,000 for consumers and 30 percent up to \$30,000 for businesses. Efforts are underway to renew this credit.

#### PRIVATE INCENTIVES

##### Electric Vehicle Supply Equipment (EVSE) Incentive—Coulomb Technologies

Coulomb Technologies' [ChargePoint America](#) program offers EVSE at no cost to individuals or entities in the metropolitan Washington region. To be eligible for free home charging stations, individuals living within the specified area must purchase a qualified plug-in EV. In most cases, the EVSE owner will pay for the installation; some cities, states, and utilities provide funding toward installation costs. All participants in the ChargePoint America program must agree to anonymous data collection after installation.

##### Electric Vehicle Supply Equipment (EVSE) Incentive—ECotality

Through [The EV Project](#), ECotality offers EVSE at no cost to individuals in the metropolitan Washington region. To be eligible for free home charging stations, individuals living within the specified areas must purchase a qualified plug-in electric vehicle (PEV). Individuals purchasing an eligible PEV should apply at the dealership at the time of vehicle purchase. The EV Project

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<sup>74</sup> 26 U.S.C. 30D. New Qualified Plug-in for Electric Drive Motor Vehicles. Available at <http://www.gpo.gov/fdsys/>



Incentive Program also covers most, if not all, of the costs of EVSE installation. All participants in The EV Project Incentive Program must agree to anonymous data collection after installation.

## UTILITY INCENTIVES

### **Plug-In EV Charging Rate Reduction. Virginia Dominion Power**

Virginia Dominion Power offers two rates for residential customers who own qualified PEVs: the Electric Vehicle Pricing Plan and the Electric Vehicle + Home Pricing Plan. The Electric Vehicle Pricing plan allows PEV owners to take advantage of lower rates during off-peak hours. Under this plan, customers must install an additional meter specifically for their EVSE; Dominion provides this meter at no charge. The Electric Vehicle + Home Pricing Plan is a whole-house pricing plan in which the customer's EVSE is treated as another appliance. Dominion provides a new meter at no charge to record energy usage in 30-minute intervals, allowing Dominion to apply time-of-use pricing that will encourage customers to charge their PEV during off-peak hours. PEV pricing plans are expected to expire on November 30, 2014. For more information, see the Dominion Plug-In Electric Vehicles website.

## DISTRICT OF COLUMBIA

### **Incentives**

**Reduced Registration Fee for Fuel-Efficient Vehicles.** A new motor vehicle with an EPA estimated average city fuel economy of at least 40 mpg is eligible for a reduced vehicle registration fee of \$36. This reduced rate applies to the first two years of registration.<sup>75</sup>

**Alternative Fuel and Fuel-Efficient Vehicle Title Tax Exemption.** Qualified alternative fuel vehicles (AFVs) and motor vehicles with an EPA estimated average city fuel economy of at least 40 mpg are exempt from the excise tax imposed on an original certificate of title. The District of Columbia Department of Motor Vehicles determines which AFVs qualify for this exemption.<sup>76</sup>

**Alternative Fuel Vehicle Exemption from Driving Restrictions.** Certified clean fuel vehicles are exempt from time-of-day and day-of-week restrictions and commercial vehicle bans, if these vehicles are part of a fleet that operates at least 10 vehicles in an ozone nonattainment area, as defined by the Clean Air Act. This exemption does not permit unrestricted access to HOV lanes, except for covered fleet vehicles that have been certified by EPA as Inherently Low Emission Vehicles (ILEVs) and that continue to be in compliance with applicable ILEV emission standards.<sup>77</sup>

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<sup>75</sup> District of Columbia Code 50-1501.03. Available at <http://government.westlaw.com/linkedslice/default.asp?SP=DCC-1000>

<sup>76</sup> District of Columbia Code 50-2201.03(j). Available at <http://government.westlaw.com/linkedslice/default.asp?SP=DCC-1000>

<sup>77</sup> District of Columbia Code 50-702 and 50-714. Available at <http://government.westlaw.com/linkedslice/default.asp?SP=DCC-1000>

## Laws and Regulations

**Alternative Fuel Vehicle Acquisition Requirements.** Fleets that operate at least 10 vehicles in an ozone nonattainment area, as defined by the Clean Air Act, must ensure that 70 percent of newly purchased vehicles with a GVWR of 8,500 lbs. or less and 50% of vehicles with a GVWR between 8,500 lbs. and 26,000 lbs. are clean fuel vehicles. Clean fuel includes diesel, ethanol (including E85), hydrogen, liquefied petroleum gas, natural gas, reformulated gasoline, or other power source (including electricity) used in a clean fuel vehicle that complies with standards and requirements applicable to such vehicles. Certain exemptions apply.<sup>78</sup>

## MARYLAND

### Incentives

**EVSE Tax Credit.** Effective July 1, 2011, the Maryland Energy Administration (MEA) offers an income tax credit equal to 20 percent of the cost of qualified EVSE that meets the definition of qualified alternative fuel vehicle refueling property as set forth in the Internal Revenue Code. The credit may not exceed \$400 or the state income tax imposed for that tax year, whichever is greater. The tax credit is limited to one EVSE system per individual and 30 EVSE systems per business entity. Individuals and businesses must apply to MEA for the credit. Unused credits may not be carried over.<sup>79</sup>

## Laws and Regulations

**Plug-In Electric Vehicle Tax Credit.** Purchasers of qualified EVs and PHEVs may apply for a tax credit of up to \$2,000 against the imposed excise tax. The tax credit is limited to one vehicle per individual and 10 vehicles per business entity. Vehicles must be registered in Maryland, unless the vehicle manufacturer conforms to applicable state or federal laws or regulations governing clean-fuel vehicles or EVs during the year in which the vehicle was purchased or the vehicle was originally registered in another state. A qualified vehicle must meet the following criteria:

- Has a GVWR below 8,500 lbs.;
- Can achieve a maximum speed of at least 55 mph;
- Is a two-, three-, or four-wheeled vehicle;
- Is propelled to a significant extent by an electric motor that draws electricity from a battery with a capacity of at least four kilowatt hours in the case of a four-wheeled motor vehicle or at least 2.5 kilowatt hours in the case of a two- or three-wheeled motor vehicle;

<sup>78</sup> District of Columbia Code 50-702–50-703. Available at <http://government.westlaw.com/linkedslice/default.asp?SP=DCC-1000>

<sup>79</sup> Maryland House Bill 163, 2011, and Maryland Tax General Code 10-729. Available at <http://mlis.state.md.us>

- Has not been modified from original manufacturer specifications; and
- Was purchased between October 1, 2010, and July 1, 2013.

**Electric Truck Purchase Vouchers.** MEA provides vouchers for the purchase of new all-electric trucks. Eligible vehicles must have a GVWR over 10,000 lbs. and be registered for on-road use in the state of Maryland. Vouchers of \$20,000 are available for qualified vehicles purchased from a dealership in Maryland or directly from a manufacturer located outside of Maryland. Vouchers of \$15,000 are available for qualified vehicles purchased through a dealership located outside of Maryland. Applications are limited to five vouchers per motor carrier. The voucher program ends December 31, 2013. See the [Maryland Electric Truck Voucher Program](#) website for more information.

**Hybrid Electric Vehicle (HEV) Exemption from Vehicle Testing Requirements.** Qualified HEVs are exempt from certain mandatory motor vehicle emissions and inspection testing requirements until September 30, 2012, if the vehicle obtains a fuel economy rating from EPA of at least 50 mpg during city driving. A qualified HEV must meet the current vehicle exhaust standard set under the federal Tier 2 program for gasoline-powered passenger vehicles and be able to draw propulsion energy from the following on-board sources of stored energy: (1) gasoline or diesel fuel and (2) a rechargeable energy storage system. Zero emissions vehicles are also exempt from certain mandatory motor vehicle emissions and inspection testing requirements.<sup>80</sup>

**Provision for Plug-In Electric Vehicle Charging Incentives.** By June 30, 2013, the Maryland Public Service Commission (PSC) must establish a pilot program for electric customers to charge all-electric (EVs) and plug-in hybrid electric vehicles (PHEVs) during off-peak hours. The pilot program must include at least two electric companies and provide incentives for residential, commercial, and governmental customers to charge EVs and PHEVs. The incentives should increase the efficiency and reliability of the electric distribution system and lower electricity use at times of high demand. The incentives may include time-of-use pricing, credits on distribution charges, rebates on the cost of charging systems, demand response programs, or other incentives approved by the PSC.<sup>81</sup>

## VIRGINIA

### Incentives

**Alternative Fuels Grants and Loans.** The Alternative Fuels Revolving Fund is used to distribute loans and grants to municipal, county, and commonwealth government agencies to

<sup>80</sup> Maryland Transportation Code 23-206.3–206.4. Available at <http://mlis.state.md.us>

<sup>81</sup> Maryland Senate Bill 279, 2011; Maryland Public Utilities Code 7-2011. Available at [mlis.state.md.us](http://mlis.state.md.us)

support AFV programs; pay for AFV maintenance, operation, evaluation, or testing; pay for vehicle conversions; or improve alternative fuel infrastructure. Eligible alternative fuels include electricity, hydrogen, and natural gas. Projects with a funding match are given priority in the evaluation process.<sup>82</sup>

**High Occupancy Vehicle (HOV) Lane Exemption.** AFVs displaying the Virginia Clean Special Fuels license plate may use Virginia HOV lanes, regardless of the number of occupants, until July 1, 2012. For HOV lanes serving the I-95/I-395 corridor, only registered vehicles displaying Clean Special Fuels license plates issued before July 1, 2006, are exempt from HOV lane requirements. For HOV lanes serving the I-66 corridor, only registered vehicles displaying Clean Special Fuels license plates issued before July 1, 2011, are exempt from HOV lane requirements. Eligible vehicles include dedicated AFVs and some hybrid EVs; see the Virginia Department of Motor Vehicles website for a complete list of qualifying vehicles. The annual fee for Clean Special Fuels license plates is \$25, in addition to the prescribed fee for commonwealth license plates.<sup>83</sup>

**Alternative Fuel Vehicle and Fueling Infrastructure Loans.** The Virginia Board of Education may use funding from the Literary Fund to provide loans to school boards that convert school buses to operate on alternative fuels or construct alternative fueling stations.<sup>84</sup>

**Alternative Fuel and Hybrid Electric Vehicle Emissions Testing Exemption.** The Virginia emissions inspection program, which requires biennial inspections of motor vehicles, does not apply to vehicles powered by compressed or liquefied natural gas, liquefied petroleum gas (propane), hydrogen, a combination of compressed natural gas and hydrogen, or electricity. Qualified HEVs with EPA fuel economy ratings of at least 50 mpg (city) are also exempt from the emissions inspection program unless remote sensing devices indicate that the HEV may not meet current emissions standards.<sup>85</sup>

## **Laws and Regulations**

**Authorization for Plug-In Electric Vehicle Charging Rate Incentives.** The Virginia State Corporation Commission (SCC) directs public utilities to evaluate time-differentiated rates and other incentives to encourage off-peak EV and PHEV charging. The SCC may authorize public utilities to conduct pilot programs to determine the feasibility and implications of offering off-peak rates and other incentives. Pilot programs may include voluntary load control options, rate

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<sup>82</sup> Virginia Code 33.1-223.4 and 33.1-223.7. Available at <http://leg1.state.va.us/000/src.htm>

<sup>83</sup> Virginia Code §33.1-46.2 and 46.2-749.3. Available at <http://leg1.state.va.us/000/src.htm>

<sup>84</sup> Virginia Code §22.1-146. Available at <http://leg1.state.va.us/000/src.htm>

<sup>85</sup> Virginia Code §46.2-1177–46.2-1178. Available at <http://leg1.state.va.us/000/src.htm>

structures with financial incentives, rebates, or other incentives that offset the cost of purchasing or installing EVSE for users who elect off-peak rate structures. An electric utility that participates in an approved pilot program may be entitled to recover annually the costs of its participation in any pilot program conducted on or after January 1, 2011.<sup>86</sup>

**Retail Electric Vehicle Charging Regulations.** Retail PEV charging services provided by an individual who is not a public utility, public service corporation, or public service company do not constitute the retail sale of electricity if the electricity is used solely for transportation purposes and the person providing the PEV charging service has procured the electricity from an authorized public utility. The Virginia SCC may not set rates, charges, or fees for retail PEV charging services provided by nonutilities.<sup>87</sup>

**Provision for Alternative Fuel Vehicle Tax Reduction.** Local governments may reduce personal property taxes paid on AFVs, specifically on vehicles that operate using natural gas, liquefied petroleum gas or propane, hydrogen, or electricity, including low-speed vehicles.<sup>88</sup>

#### Sources

U.S. Department of Energy Alternative Fuels & Advanced Vehicles Data Center website (<http://www.afdc.energy.gov>).

Electric Auto Association Plug In America website ([www.pluginamerica.org/incentives](http://www.pluginamerica.org/incentives)).

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<sup>86</sup>Virginia House Bill 2105, 2011. Electric Vehicle Charging Service. Available at <http://legis.state.va.us/> and Virginia Code 56-232.2. Available at <http://leg1.state.va.us/000/src.htm>

<sup>87</sup> Virginia Code 56-1.2 and 56.232.1:1. Available at <http://leg1.state.va.us/000/src.htm>

<sup>88</sup> Virginia Code 58.1-3506. Available at <http://leg1.state.va.us/000/src.htm>

## APPENDIX J

### PROMOTING EVS THROUGH COMPREHENSIVE PLANS

At the request of COG staff, Fairfax County planning staff prepared several examples of comprehensive plan text that could be applied to promote EV planning at various levels of expectation and specificity. These examples do not reflect county endorsement of any particular policy directions but are intended only as examples of various approaches that could be taken by localities. Further, this list is not comprehensive, as there are other policy approaches that could be taken.

- a) *“Encourage the provision of charging stations and related infrastructure for EVs within new development and redevelopment proposals.”*
  - Establishes general support for EV charging; however, it does not impose a requirement.
- b) *“Encourage the provision of charging stations and related infrastructure for electric vehicles within new development and redevelopment proposals, particularly for residential proposals where other vehicle charging opportunities would not be available.”*
  - Puts emphasis on residential projects.
- c) *“Encourage readiness for charging stations and related infrastructure for electric vehicles within new development and redevelopment proposals.”*
  - Puts emphasis on EV-ready design.
- d) *“Ensure that zoning proposals will incorporate the provision of charging stations and related infrastructure for electric vehicles.”*
  - Establishes an expectation for installation of EV charging facilities for all development proposals, without identifying specific thresholds.
- e) *“Ensure that zoning proposals for multifamily residential development at or above the mid-point of the Plan density range will incorporate the provision of charging stations and related infrastructure for electric vehicles.”*
  - Establishes an expectation for installation of EV charging facilities for certain development proposals, without identifying specific thresholds.
- f) *“Ensure that zoning proposals will incorporate the provision of charging stations and related infrastructure for electric vehicles. There should be at least one charging station provided for every XXXX parking spaces; charging stations should have charging times no longer than those of Level 2 charging stations as described in ‘{insert name of guidance document}.’”*

- Establishes an expectation for installation of EV charging facilities for all development proposals, with specific thresholds established.

## APPENDIX K

### UTILITY POLICY BEST PRACTICES FROM CALIFORNIA

#### **CALIFORNIA PUBLIC UTILITIES COMMISSION (PUC) DECISION ON REGULATORY STATUS, RATES, AND NOTIFICATION**

The California Public Utilities Commission (PUC) began its decision-making process for electric vehicle (EV) policy in late 2009.<sup>89</sup> The case, titled Rulemaking 09-08-009, considered tariffs, infrastructure, and policies needed for California investor-owned electric utilities to prepare the electricity system for projected growth in the light-duty, plug-in vehicle market across the state.

The rulemaking proceeded in three phases. Phase 1 concerned the status of EVs in the state's Public Utilities Code.<sup>90</sup> The PUC decided that EV charging stations should not be regulated as public utilities.

Phase 2 delved into a number of deeper policy issues, including rate design, notification, separate metering, utility cost recovery policy, and education and outreach programs.<sup>91</sup> The decision was as follows:

- Directs electric utilities to collaborate with automakers, state agencies, and other stakeholders to develop a notification process for the purposes of infrastructure planning and to create a data clearinghouse that contains relevant data about existing electric vehicles in the state.
- Affirms that the electric utilities' existing residential PEV rates are sufficient for early PEV market development.
  - Each utility offers at least two options for PEV pricing, including rates that increase as the customer's monthly cumulative usage increases and time-of-use rates that increase in peak usage hours. The existing PEV rate schedules vary in regard to requiring a second meter for EVSE.
  - However, for separately metered residential PEV customers, the Commission recommends opt-in, nontiered, time of use pricing. That is, the rates (1) should be voluntary for the customer, (2) will not increase with cumulative monthly consumption, and (3) will reflect peak versus nonpeak consumption.

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<sup>89</sup>Public Utilities Commission of the State of California. *Alternative-Fueled Vehicle Information*. Available at [http://www.cpuc.ca.gov/PUC/hottopics/1Energy/090814\\_ev.htm](http://www.cpuc.ca.gov/PUC/hottopics/1Energy/090814_ev.htm)

<sup>90</sup>Public Utilities Commission of the State of California. Rulemaking 09-08-009, Proposed Decision of Commissioner Ryan. May 21, 2010. Available at <http://docs.cpuc.ca.gov/efile/PD/118345.pdf>

<sup>91</sup>Public Utilities Commission of the State of California. Rulemaking 09-08-009, Proposed Decision of Commissioner Peevey. Available at <http://docs.cpuc.ca.gov/efile/PD/132120.pdf>



- Similarly, affirms that existing commercial and industrial rates, which include time-of-use pricing, are sufficient in the early PEV market for nonresidential EV charging stations.
- Supports offering a variety of EV metering options to residential customers.
  - The PUC decided that to promote customer choice and to avoid requirements that might in the future become unnecessary, both single metering and separate metering of EV charging should be allowed.
  - However, to ensure that minimum data and technological functionality is preserved, the PUC decided that all meters should, at a minimum, be Advanced Metering Infrastructure (AMI) and Health Area Network (HAN) enabled.
  - In addition, the cost of a separate PEV meter should be borne by the customer, not the rate base. The PUC supports a monthly charge to recoup this cost.
  - Submetering may offer a lower-cost alternative, but utilities will need to develop a technical protocol for PEV submeters before they are allowed.
- Determines that, on an interim basis—until June 30, 2013, when a report on the grid impacts of PEVs is due to the Commission—the costs of any distribution or service facility upgrades necessary to accommodate residential PEV charging will be treated as a shared costs.
- Acknowledges that utilities have a unique role in communicating information to current and potential EV owners due to their existing relationship with the customers. While it is not appropriate for utilities to actively promote PEV adoption, they should engage in customer education about metering arrangements, rates, demand response programs, EVSE equipment, EVSE installation, safety, reliability, and off-peak charging.

The Commission reserved a number of issues for Phase 3 and subsequent rulemakings, including whether to adopt uniform national standards for EVs and the impact of EVs on state greenhouse gas and renewable energy policy.<sup>92</sup>

#### **CALIFORNIA—JOINT INVESTOR OWNED UTILITY ASSESSMENT REPORT FOR PLUG-IN ELECTRIC VEHICLE (PEV) NOTIFICATION**

Pursuant to the California PUC’s Phase 2 EV Decision, three major California Investor Owned Utilities submitted a joint report analyzing notification options for EVs.<sup>93</sup> The report was filed in December 2011.

<sup>92</sup> Public Utilities Commission of the State of California. Rulemaking 09-08-009, Filed August 20, 2009. *Administrative Law Judge’s Ruling—Phase 3*. Available at <http://docs.cpuc.ca.gov/efile/RULINGS/158505.pdf>

<sup>93</sup> Public Utilities Commission of the State of California. Rulemaking 09-08-009, Filed August 20, 2009. *Joint IOU Assessment Report for PEV Notification*. Available at <http://docs.cpuc.ca.gov/efile/REPORT/156710.pdf>

The following are key features of EV notification data that were identified in the report:

- **Exhaustiveness.** Notification data should cover as many charging locations as possible to ensure distribution system stability.
- **Granularity.** Notification data should include street-address-level information and charging rate to conduct all necessary infrastructure assessments on impacted distribution equipment (the investor-owned utilities [IOUs] expect impacts from charging PEVs mainly on neighborhood distribution infrastructure).
- **Timeliness.** Notification data and processes should allow time for the IOUs to conduct infrastructure assessments and execute necessary upgrades as soon as possible.
- **Scalability.** Notification processes and systems should be scalable to PEV market growth.
- **Costs.** Notification processes and systems should carry the least internal and external costs.

In California, utilities found that no single EV notification source provided data that met all of the above criteria. Therefore, a combination of notification methods is recommended to meet these information needs.

The utilities anticipate that they could eventually source PEV notification data primarily from the Department of Motor Vehicles and supplement the data through a combination of secondary sources, including original equipment manufacturers, local government, customers, and possibly load-scanning capabilities.