Electric Vehicle Readiness Plan
for the
Metropolitan Washington Region

Prepared by

Metropolitan Washington Council of Governments (COG)

for

Climate, Energy, and Environment Policy Committee (CEEPC)

&

COG Board of Directors

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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 MW COG region states, no participant should be deemed to endorse or support all of the conclusions or recommendations contained in this report

Section 1
Introduction

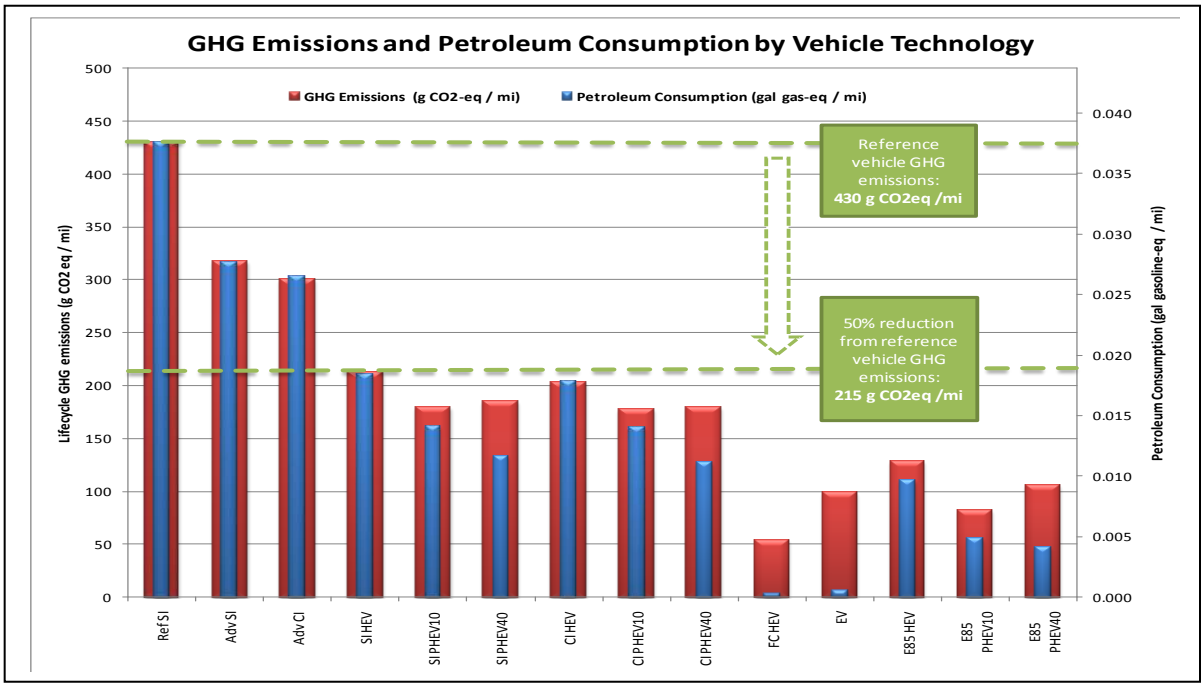
Goals

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.

Figure 1.1



Source: Breakthrough Technologies Institute/U.S. Department of Energy, 2012[1]

[1] http://www1.eere.energy.gov/vehiclesandfuels/pdfs/program/vt_mypp_2011-2015.pdf

Ref. SI – 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)

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. While EVs are associated with power plant emissions, compared with internal combustion engines emissions associated with EV charging are lower overall and do not produce the unhealthy local concentrations along roadways that conventional vehicles do.

EVs also offer economic benefits through fuel cost savings. Theyhave very high energy efficiency ratings compared with conventional cars and can achieve as high as 94–112 miles per gallon equivalent (MPGe). This efficiency gain can translate 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,[2] compared with $0.10 to $0.15 per mile for conventional cars (see 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
Electric efficiency (kWh/mile)	0.3	0.32	0.34	0.36
Energy efficiency rating (MPGe)	112	105	99	94

Source: www.fueleconomy.gov

While studies have shown that it can take seven years or more for the operational savings to pay off the incrementally higher up-front cost to buy an EV (even when gas prices are in the $4–$5 range), EV buyers are 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

[2] 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 2012)

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.

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.

Mahi Reddy, CEO and founder of SemaConnect, and Maryland Governor Martin O'Malley celebrate the installation of eight SemaConnect electric vehicle charging stations at Baltimore/Washington International Thurgood Marshall Airport.

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."[3] 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 specifically for ambient pollutant concentrations to fall below federal standards.

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

[3] Metropolitan Council of Governments. *Region Forward: Sustainability Targets.* Available at http://www.regionforward.org/sustainability-targets

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."[4] The Union of 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_{ghg}) by Electricity Generation Source

Electricity Source	EV Global Warming Emissions in Gasoline Miles per Gallon Equivalent (mpg_{ghg})
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. *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/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.[5] In addition, the electricity

[4] Metropolitan Council of Governments. *Region Forward: Sustainability Targets.* Available at http://www.regionforward.org/sustainability-targets

[5] 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

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.

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 these reductions. In the metropolitan Washington region, transportation emissions accounted for 55 percent of NOx emissions and 16 percent of fine particle ($PM_{2.5}$) 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. 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.

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 publically 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 help promote EV acceptance.

The current low market demand for plug-in 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 no agreement 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 benefits. In fact, DOE's investments in EV infrastructure between 2009 and 2011 has been a significant factor in the deployment of EVs in California, Oregon, and Washington.

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 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.

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 most local jurisdictions in the region were not aware of or looking at EVs as a potential issue. The results of the survey are discussed in Section 4, and survey questions and detailed results are provided in Appendix D. COG has also created a compilation of resources, which is provided in Appendix C.

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.*[6] 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.

[6] COG Department of Transportation Planning. *What Would It Take? Transportation and Climate Change in the National Capital Region.* May 18, 2010. Available at http://www.mwcog.org/uploads/committee-documents/kV5YX1pe20100617100959.pdf

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.

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 to be used 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). These projects are described at length in Section 3.

DOE is actively promoting EVs through grants to Clean Cities Coalitions, local governments, and EV infrastructure companies. Although not a major beneficiary of DOE EV grants, the metropolitan Washington region may benefit from grants supporting electric vehicle supply equipment (EVSE) infrastructure in Baltimore and Richmond.

Planning Strategy Development in the Metropolitan Washington 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 initiated a new regional EV Planning Initiative. The EV Planning Initiative was 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 EV Planning Workgroups (referred to 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, energy utility policy, 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 municipal roles that could be considered:

- Reducing barriers/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;
- 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 a 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. The next section discusses current EV ownership and charging stations in the region, with implications for infrastructure planning. Comprehensive plans, zoning, codes, and permitting and inspections are key to preparing for and promoting EV readiness in the region—the section on Municipal 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 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 Definitions, Models, Manufacturers, and Network Developers

To understand the challenges and constraints affecting the adoption of electric vehicle (EV) technology in the metropolitan Washington region, it's helpful first to ascertain the current state of EV and electric vehicle supply equipment (EVSE) technologies and markets. This section presents some background on these technologies, followed by descriptions and photos of EV models—those that are now on the market and others that are upcoming or in limited release. Then, some background on EVSE 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 the EVSE suppliers to set up and manage charging networks, and those who develop and distribute related software products.

Types of 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.[7]

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

[7] 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. 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

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.[8]

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 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.

[8] 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

Table 2.1

What are the Benefits of Electric Drive Vehicles?			
Benefits	**Hybrid Electric Vehicles**	**Plug-In Hybrid Electric Vehicles**	**All-Electric Vehicles**
Fuel Economy 	**Better than similar conventional vehicles** The fuel savings of driving a Honda Civic Hybrid versus a conventional Civic is about 38% in the city and 20% on the highway.	**Better than similar HEVs and conventional vehicles** PHEVs use 40% to 60% less petroleum than conventional vehicles and permit driving at slow and high speeds using only electricity.	**No liquid fuels** Fuel economy of EVs is usually expressed as cost per mile, which is discussed below.
Emissions Reductions 	**Lower emissions than similar conventional vehicles** 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.	**Lower emissions than HEVs and similar conventional vehicles** 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.	**Zero emissions** 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.
Fuel Cost Savings 	**Less expensive to operate than a conventional vehicle** 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.	**Less expensive to operate than an HEV or conventional vehicle** 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.	**Less expensive to operate than conventional vehicles** 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).
Fueling Flexibility 	**Same as conventional vehicles**	**Can get fuel at gas stations or charge at home or public charging stations**	**Can charge at home or public charging stations**

Source: Alternative Fuels and Advanced Vehicles Data Center, 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 2011. As of May 2012, nearly 12,000 LEAFs and more than 13,000 Volts had been sold nationwide. Third in sales is the Toyota Prius Plug-in Hybrid, which entered select markets in February 2012. About 2,500 were sold in the first three months that it was available. The Prius PHEV is expected to be released nationally in 2013. In the light truck category, Ford's Transit Connect EV provides an electric drive option for businesses. This commercial van entered production in 2010. The Fisker Karma PHEV provides an EV option in the luxury car category. Details and photos of each of these models 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

Ford Azure Transit Connect

Fuel: electric (dedicated)

Class: van

Estimated Range: 56 miles per charge

Battery: li-ion

Emission Certification: Tier 2 Bin 1, ZEV

Engine: 52 kW e-motor

Availability: nationwide

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

Charging Equipment

Different types of charging equipment are now available, and charging performance will likely continue to improve. Fast charge EVs and PEVs are powered 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. The current type and voltage of the EVSE connection, the type and capacity of the battery, and the depletion level of the battery when connected all determine the charging time. Three main charging equipment 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. 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 home charging or public charging equipment. It requires a 240-volt AC plug and a 40-amp circuit. Level 2 charging also uses a J1772 connector 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) charging uses a 480-volt connection to provide 50kW to EV batteries. It provides a full charge in less than 30 minutes, enabling charging along heavy traffic corridors and at public charging stations. Most DC fast chargers today 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

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

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						
	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, 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.[9] 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,

Plug-In 2011 Conference & Exposition, Raleigh, NC

[9] 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

retail/commercial, and fleet-charging settings. Two common designs are the free-standing "pedestal" and the wall-mounted charger.

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 aims to provide 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 metropolitan Washington region is to identify regional obstacles to significant local deployment and 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

Locating Electric Vehicle Charging Stations

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 EV ownership will continue to be 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.

EV Ownership

Outlook for EV Markets

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

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.[10] 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.[11]

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.[12] In that time, 1.3 million EVs have been sold, including hybrid, plug-in hybrid, extended-range, battery, and fuel cell vehicles.[13]

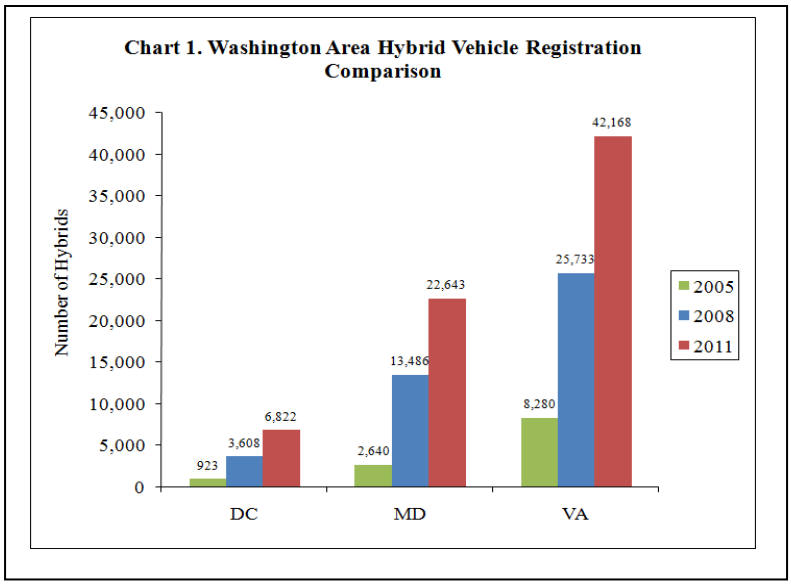
Industry experts suspect that constraints on the availability of the most popular models, the Nissan LEAF EV and the Chevy Volt plug-in hybrid electric vehicle (PHEV), have held back growth in the EV segment in recent years. In 2011, the LEAF was available in only 30 states, and all cars produced that 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

[10] Natural Resources Defense Council. *Relieving Pain at the Pump*. May 2, 2012. Available at http://www.nrdc.org/energy/relievingpainatthepump.asp
[11] U.S. Department of Energy. *2011–12 Electric Vehicles.* Available at http://www.fueleconomy.gov/feg/evsbs.shtml
[12] 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
[13] 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

companies have announced higher production for 2012, which is expected to open the market to additional growth.[14]

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 for a detailed description of OEM vehicle offerings.

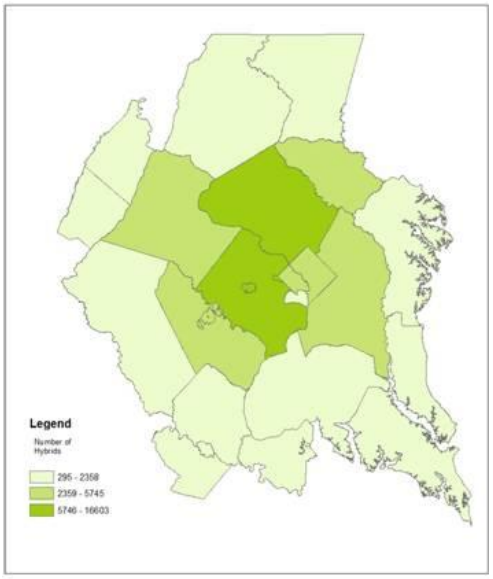
OEMs are currently offering the Nissan LEAF and Chevy Volt in the metropolitan Washington region. PHEVs such as the Toyota Prius are also being sold in the region. Fitzgerald Toyota in Gaithersburg, Maryland, offers a service to convert the standard Prius to a PHEV. Starting in April, Toyota also began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



[14] 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 exact 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 estimated to be fewer than 500 EVs registered in the metropolitan Washington region. Hybrid vehicles offer an example of where and how new vehicle technology is adopted in the Washington region. Figure 3.1 shows the growth of hybrid vehicle registrations in the District of Columbia, Maryland, and Virginia. As of 2009, there were believed to be approximately 57,000 EVs in operation nationwide.[15] The U.S. Department of Energy (DOE) projects that there could be 1.2 million EVs on the road by 2015.[16]



One approach to predicting future EV demand is to analyze the experience of hybrid vehicles and the early adopters. 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 (see Figure 3.2).

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

[16] 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

COG staff was also able to document generally where the early adopters of hybrid vehicles are located. If EV market adoption in the region resembles anything like the growth in hybrids, the region could experience the following trends:

- Early adopters may be found in clusters, with potentially higher concentrations in Fairfax, Arlington, and Alexandria, Virginia, and in the District of Columbia.
- Electric vehicle ownership may be concentrated in the Virginia suburbs in the initial stages of electric vehicle adoption
- As a low estimate, by 2015/2020, the region could have 1,500 to 3,000 EVs operating on the roadways.
- As a high estimate, if EVs are adopted as rapidly as hybrids, the region could see anywhere from 50,000 to 75,000 EVs operating on the roadways by 2020.

Factors Impacting EV Adoption and Location

The potential need for public/private charging infrastructure siting in the metropolitan Washington region can be informed by examining a variety of regional characteristics and trends, such as

- Housing type: number and distribution of households with and without access to private driveway or garage
    - Indicates location of home charging stations and need for multifamily, EV car share, workplace or other destination infrastructure
- Location of hybrid vehicle owners, households with higher income
    - Indicates possible location of early EV adopters
- Location of workplaces with 20–40 mile vehicle commutes[17]
    - Commutes of 20–40 miles are good EV candidates. Lower commutes can be made on one charge; higher commutes may be out of EV charging range.
- Households with more than one vehicle
    - For early adopters, the second car is most viably replaced with an EV.

[17] Metric used by Western Washington Clean Cities Coalition, http://www.wwcleancities.org/index.html

- Comparative number of trips by vehicle in the central core, inner suburbs, and outer suburbs, and outer ring[18]
    - Vehicle trips are distributed differently across the region-- EV charging infrastructure demand might follow similar patterns
- Number of vehicle trips to nonwork, nonhome destinations
    - Indicates popular recreational, retail destinations
- Length of vehicle trips by destination
    - Indicates relationship of trip length to vehicle charging needs

Summary of Vehicle Ownership and Travel Patterns for Metropolitan Washington

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. For most daily commutes and other trip purposes, the relatively 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.

[18] 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. http://www.mwcog.org/committee/committee/archives.asp?COMMITTEE_ID=15

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. Zone 702, shown in Figure 3.3, exhibits several factors that indicate potential for charging station demand.

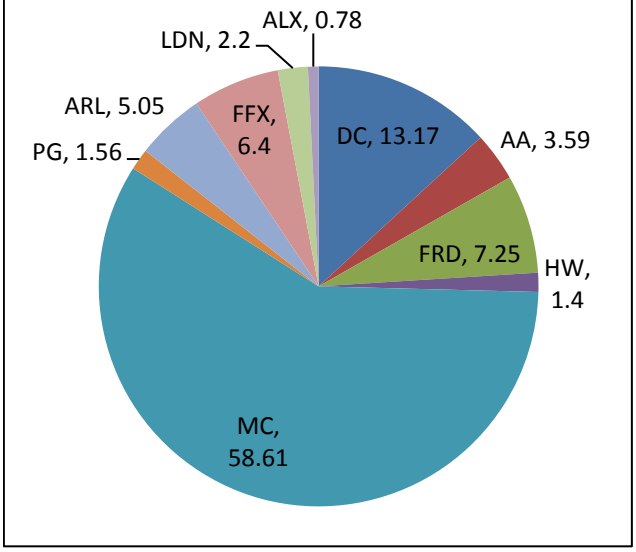


Figure 3.3. Breakdown of Where Workers of TAZ 702 Live. 77% of workers who drive live within the 20 mile EV range of TAZ 702.

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 work place, about the current EV range (see Figure 3.4). 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.

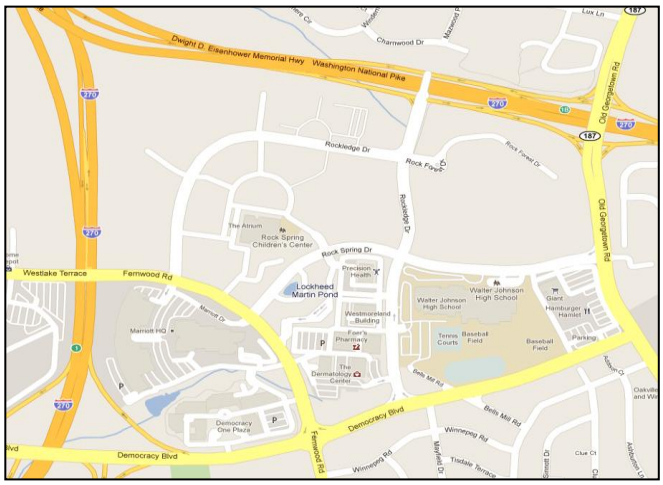
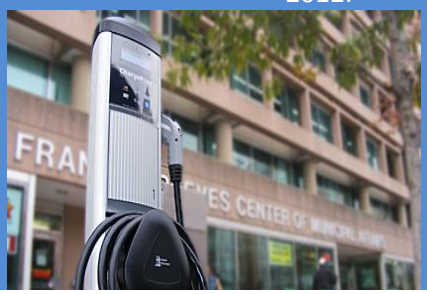


Figure 3.4. Transportation Analysis Zone 702. Source: googlemaps.com

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.

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 14th & 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.



The next section 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.

Considerations and Opportunities by Site Type

Figure 3.5 list the suitability of different types of charging stations for different vehicle use and location.

Homes (vehicle spends 8–12 hours parked) will see the highest demand for charging.

- *Single family homes* that have garages or driveways are the most straightforward locations.
- As shown in Figure 3.6, single-family home ownership is common in many regional jurisdictions. A local permit may be required if an EV charging unit is installed.

Figure 3.5. 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 Locations - Full charge 4 to 6 hours
Destination Locations
- Where people shop, play, gather
- Target is 1 to 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 "Gargeless" 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

- *Town homes* without garages or driveways will have special charging station location needs.

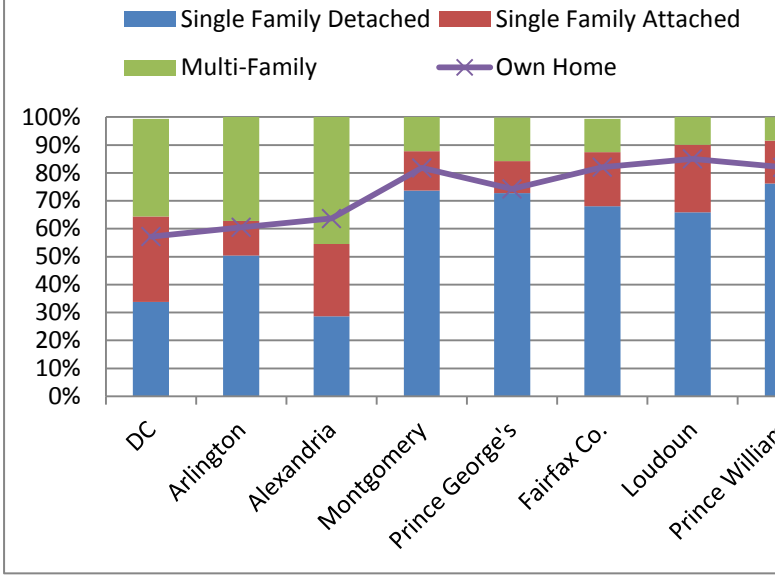


Figure 3.6. Housing Type by Jurisdiction. A majority of residents in DC and Alexandria live in multifamily or single family attached housing, while single family home ownership is common in other jurisdictions. *Source*: 2007/2008

- *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.

Work (vehicle spends typically 6–10 hours parked) may be the second-most-used location for charging EVs, behind home charging. Workplace charging provides opportunities to attract high-quality employees and present an innovative image.

Workplace destinations 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.

Amenities and Recreation Destinations (vehicle spends typically 1+ hours) 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 designed for long stays, such as mixed-use locations. EV dealerships are also advantageous locations for charging stations.

Public Facilities (vehicle spends 1+ hours) that are publicly accessible 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 Municipal Policy).

Car Rental and Car Sharing (vehicle spends varying amount of time parked) 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.

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 3.1 lists the opportunities and challenges for EV charging stations that are posed by different types of sites.

Table 3.1
Summary of Opportunities and Issues by Site Type

Location	Opportunities	Barriers/Limitations
Single family home (with driveway or garage)	• Highest charging demand	• Many potential owners may not live in single family houses or have private driveway/garages • Knowledge • Permitting process
Multifamily residential	• Potentially high demand • Many contain parking facilities • Opportunity for car sharing	• Some may have limited parking spaces • Property owners information gap • Permitting process • Technical capability • Turnover management • Parking lot management
Workplace	• Second highest charging demand behind residential	• Knowledge • Permitting process • Technical capability • Charging turnover management • Parking lot management
Amenities and recreation	• Third highest charging demand	• Knowledge • Permitting process • Technical capability • Turnover management • Parking lot management
Rentals	• Capitalize on tourism market • Stepping stone to ownership	• Need network with rental companies, hotels, and destination parking
EV car sharing	• Regular car sharing already exists • Zipcar planning to offer a few EVs	• Permitting/technical
Public facilities	• Could help kick-start market • Demonstrate environmental responsibility • Improved air quality	• Knowledge • Permitting process • Technical capability • Charging turnover management • Parking lot management • On-street—special case

Regional Projects and EVSE Inventory

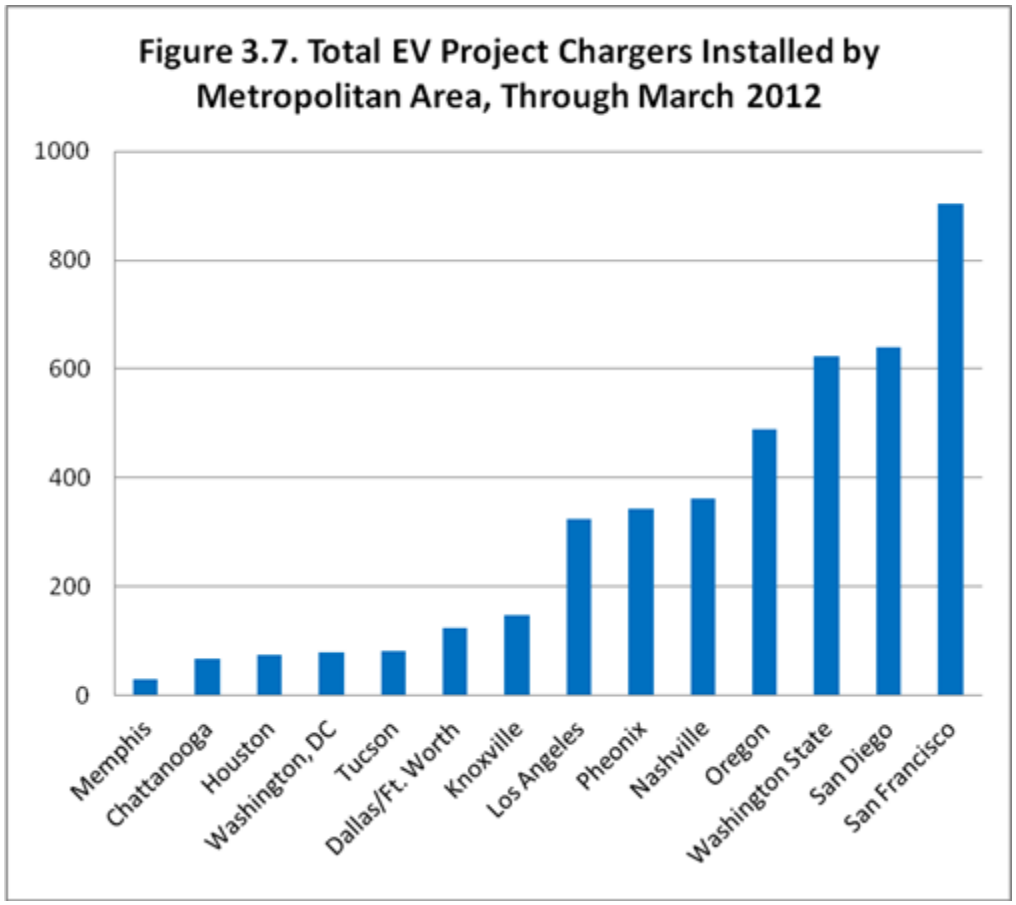
Several federally stimulated initiatives are currently siting public and residential EV infrastructure in parts of the metropolitan Washington region. They include ECOtality's The EV Project, Coulomb's ChargePoint America Program, Maryland Electric Vehicle Infrastructure Program (EVIP)/BEVI (Baltimore–Washington 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 GM 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 area. 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 metropolitan Washington region has fewer than 15 EV Project stations per million residents, while the top-ranking metropolitan area, San Francisco, has 628. Figure 3.7 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

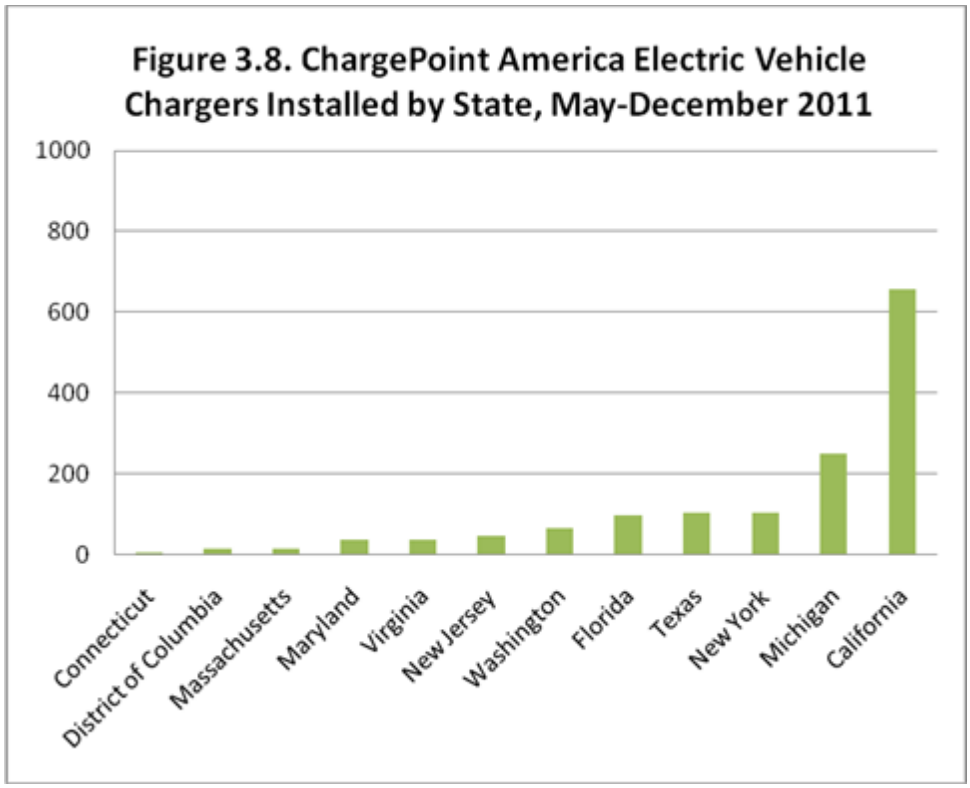
p.m. The average connection time was 10.6 hours per vehicle, but charging time averaged only two hours. Vehicles consumed an average of 6.3 AC kWh per charging event.



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 10 selected regions across the country.

Approximately 300 stations are expected in the metropolitan Washington region. [need to determine by when] 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 10 program regions.

As of December 2011, ChargePoint America had installed 1,432 charging stations across its 12 project areas. Figure 3.8 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 were not specified. The number of installed ChargePoint America stations in each program state 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.



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 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 Regional 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).

In addition to these federal iniatives, 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, has 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 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[19] 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.

Inventory of EV Publicly Accessible Charging Stations

COG staff developed an inventory of EV charging stations for the metropolitan Washington region. 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. The types of sites where these charging stations are located are detailed in Table 3.2.

[19] 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

Table 3.2

EVSE Stations by Location Type, Metropolitan Washington

	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
Total	133	332

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. Although many EV infrastructure development programs in the region involve installation of home charging stations,[20] published data on these stations are incomplete for several reasons:

- Stations are not published on EVSE provider websites or on the Alternative Fuels Data Center since they are not available for public use;

[20] 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.

- Many individuals choose not to voluntarily share their location information with Plugshare, a crowd-source EV station website; and
- Local governments issue general electrical permits for residential electrical work.

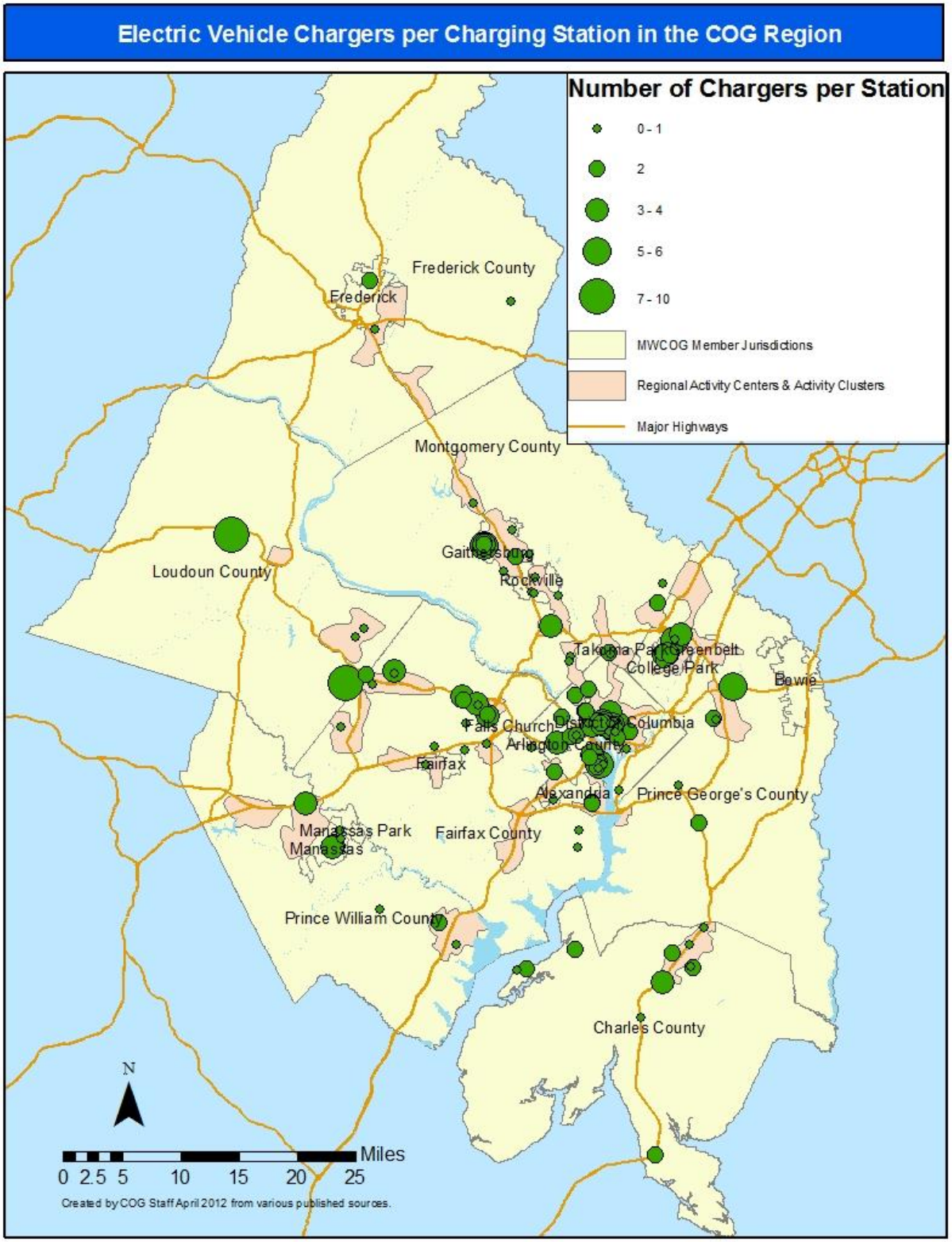
Regional EVSE Infrastructure Maps

Map 3.1 depicts published charging station location of existing and planned public and private stations.[21] 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.

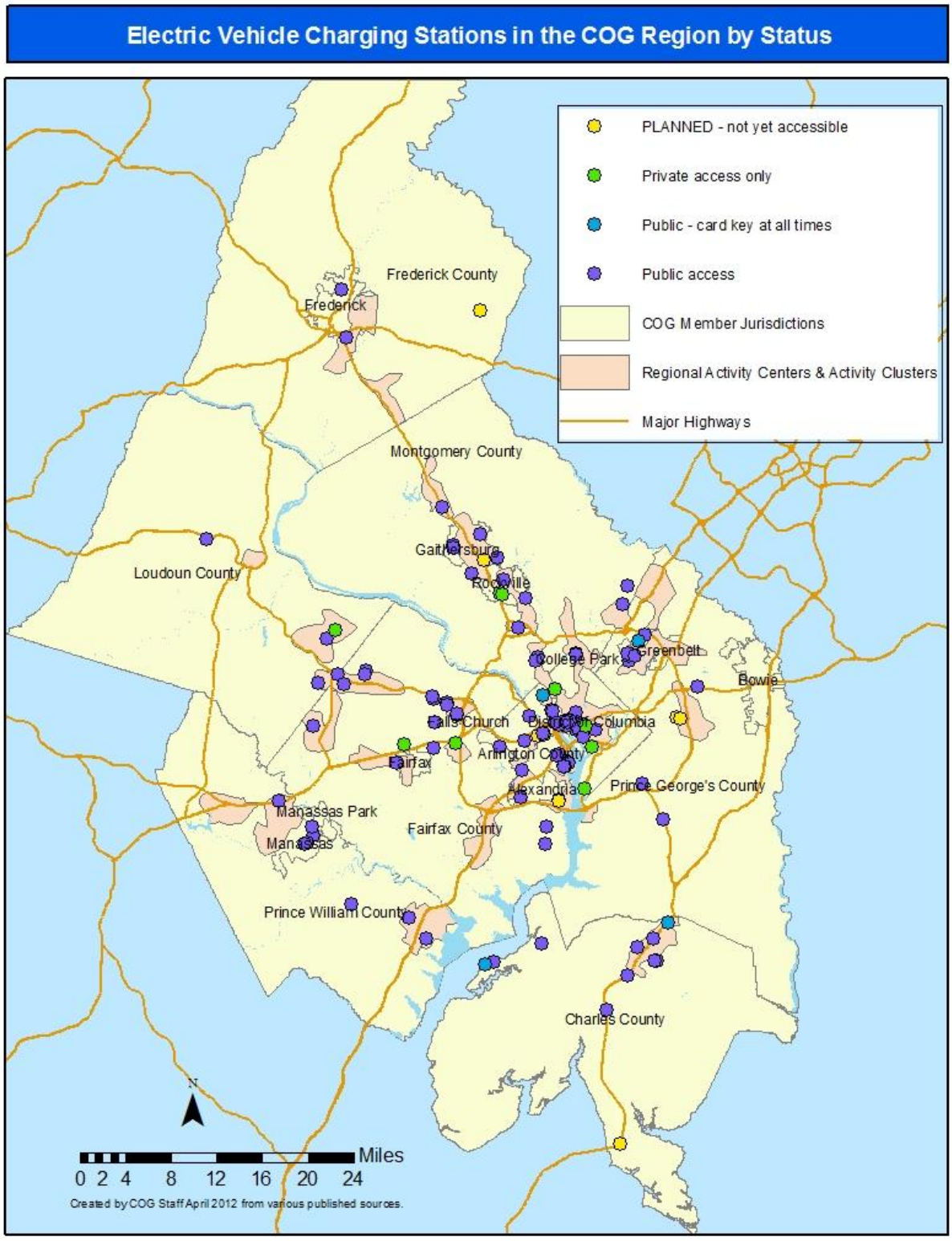
Map 3.1

[21] Maps do not include single family home stations.

Map 3.1


Electric Vehicle Chargers per Charging Station in the COG Region
Number of Chargers per Station
0 - 1
2
3 - 4
5 - 6
7 - 10
MWCOG Member Jurisdictions
Regional Activity Centers & Activity Clusters
Major Highways
Frederick County
Frederick
Montgomery County
Loudoun County
Gaithersburg
Rockville
Takoma Park
Greenbelt
College Park
Bowie
Falls Church
District of Columbia
Arlington County
Fairfax
Alexandria
Prince George's County
Manassas Park
Manassas
Fairfax County
Prince William County
Charles County
N
Miles
0 2.5 5 10 15 20 25
Created by COG Staff April 2012 from various published sources.

Map 3.2


Electric Vehicle Charging Stations in the COG Region by Status
PLANNED - not yet accessible
Private access only
Public - card key at all times
Public access
COG Member Jurisdictions
Regional Activity Centers & Activity Clusters
Major Highways
Frederick County
Frederick
Montgomery County
Gaithersburg
Rockville
Loudoun County
College Park
Greenbelt
Bowie
Falls Church
Arlington County
Fairfax
Alexandria
Prince George's County
Manassas Park
Manassas
Fairfax County
Prince William County
Charles County
N
Miles
0 2 4 8 12 16 20 24
Created by COG Staff April 2012 from various published sources.

Task Force Recommendations and Summary of Findings

Facilitating charging station implementation 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 to 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.

The recommendations below were ranked low to medium cost and medium to high on facilitation of EV deployment. Most are recommended to be implemented in the near term (0 to 2 years).

Recommendation 1: Promote EVSE siting in strategic locations and monitor EV use and EVSE installation.

a. Charging will take place primarily at home, secondarily at the workplace, and third at other destinations. Taking that into account, the market and consumer needs should drive charging station siting. EV owners with garages or driveways can benefit from streamlining of permitting and educational resources. Multifamily housing and urban dwellers are a special case because they lack access to a garage or to an electrical outlet.
b. Many workplace locations with parking such as office parks, surface parking lots, hotels, convention centers, hospitals, airports, fleet depots, and Park & Ride facilities are feasible locations for charging stations since vehicles are parked there for 6–10 hours.[22]
c. Other destination parking includes shopping centers and transportation hubs. For recreational destinations, suggested charging locations 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, and gas stations located at rest stops.
d. Public charging could be located at city halls, libraries, and on-street.

[22] Locations such as Park & Ride and airports may necessitate EVSE valet service since cars are parked there for longer periods of time.

e. EV car sharing and rental programs provide additional opportunities for charging locations.
f. Benchmark EV sales and use in Washington region and compare with other cities to identify additional needs or barriers

Recommendation 2: Equip new commercial, multifamily residential, and major public construction and redevelopment in advance with a feasible level of inexpensive technology-enabling infrastructure to reduce future installation expense.

a. Provide the physical space for transformer capacity to allow the future installation of full-lot electrification.
b. The electrical room should have physical space to allow future installation of a switchboard and capacity for submetering.
c. Parking area construction should include conduit bank and conduit between the facility's electrical room and the spaces needed for future electrification.

Recommendation 3: 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, home owners associations, and condominium associations with educational resources relating to EVSE implementation.
c. Requirements should depend on whether the units have or manage a parking facility.
d. Managers could incorporate EVs into the parking ratio.
e. Car sharing and charger sharing can help meet the needs of multifamily building residents.

Recommendation 4: Facilitate workplace charging.

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.

Recommendation 5: Promote tourist market opportunities.

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: Promote public EV infrastructure investment.

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. Municipalities should lay down a conduit for future on-street EV parking during right-of-way redevelopment.
c. Governments can grant special use permits for parking spaces. Guidance should be developed for nongovernmental entities seeking permitting of on-street charging.
d. Certify a meter in the charging station itself instead of including a separate utility meter.

Recommendation 7: Increase access to public charging stations for Levels 1 and 2.

a. EV owners suggest that municipalities issue EV charging passes at a low monthly charge that allow EV owners to use a network of simple 110V charging outlets.
b. Level 1 stations should be located in low-turnover locations such as home or workplace. Level 2 stations should be in high-turnover locations or locations with valet service or with one load control for multiple spots.
c. For Level 2, allow charging station owners/managers the ability to control turnover, such as by raising the rate after two hours.

Section 4

Municipal Policy on Comprehensive Planning, Zoning, Codes, and Permitting and Inspections

Municipalities 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, municipalities must ensure that EV infrastructure development is addressed in comprehensive planning efforts and that zoning, codes, and permitting and inspection processes provide a pathway to the expeditious installation of charging equipment. 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. 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. It also discusses best practices gleaned from EV programs across the nation and provides recommendations on how local governments across the metropolitan Washington region can better promote EV readiness.

Comprehensive Planning, Zoning, and Codes

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 municipality'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 the comprehensive plan may suggest areas for EV infrastructure development, zoning ordinances dictate where charging stations are allowed and disallowed.[23] Zoning ordinances may 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. Once adopted, the comprehensive plan must be implemented through appropriate zoning regulations and changes to the zoning districts or map.

Municipal 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 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 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 of the 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

[23] Zoning ordinances set specific standards for use, density/intensity, size, setbacks, height, and open space.

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. This language, if adopted, could provide text for negotiating commitments from developers during the zoning process to install EV charging stations.[24] See Appendix F for suggested sample language.

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, they developed the *Electric Vehicle Infrastructure: A Guide for Local Governments in*

[24] 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.pdf

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. [25] . A sample of model installation guidance for charging and installation checklist is provided in the Washington State guide Appendices.

Best Practices: ADA Compliance

Title II of the Americans with Disabilities Amendments Act of 2008 (ADA) covers all activities of state and local governments, requiring 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. [26]

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.[27] 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

[25] 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

[26] 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

[27] 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

accessible charging stations.[28] For examples of on-street and off-street accessible EV charging parking design, including ADA requirements, as wells as directional signage, see the Washington State guidance. [29]

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. [30]

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

[28] 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
[29] Washington State Department of Commerce, Electric Vehicle Infrastructure, A Guide for Local Governments in Washington State, July 2010, pp.25-31.
[30] http://vancouver.ca/*sustainability*/EVcharging.htm

wired to accommodate EV charging. This will avoid expensive retrofit wiring as the number of EV users increases.

Permitting and Inspection

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 causes 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 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 D. 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.[31] The City of Raleigh has also developed two YouTube videos on how to install public[32] and home charging equipment.[33]

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, 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. 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.

[31] City of Raleigh. *Electric Vehicle Charging Station Installation.* Available at http://www.raleighnc.gov/search/content/CityMgrDevServices/Articles/HowToElectricVehicleCharging.html

[32] City of Raleigh. *Installing Public Charging Stations* [YouTube video]. November 30, 2010. Available at http://www.youtube.com/watch?v=jvPLvsg9y2o

[33] 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=makWAtCIzgsRXZUNczyNEA

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.

In Oregon, the Electrical Specialty Code contains the minor label program,[34] 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

[34] State of Oregon, Building Codes Division. Minor Label Program. Available at http://www.bcd.oregon.gov/programs/minorlabel/minor_label_programs.html#2

The National Electrical Code (NEC), produced by the National Fire Protection Association, provides safety guidelines for electrical equipment installation. Municipalities 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.

Table 4.1
National Electrical Code (NEC) Relevant to EVSE

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 NEC 626.28-625.30 UL UL 2251	- General (Scope, Definitions, Other Articles, Voltage, Listed/Labeled) - EVSE Locations - Standard for flexible cords and cables required by NEC 625 - Cord design and safety covers the plug, cord, receptacle, connectors and other items related to the charging cord set. Also verifies the cord's safety and ability to carry its rated load.

Below are the recommended changes in municipal policy that are designed to facilitate the region's EV readiness, followed by specific recommendations related to inspections and permitting.

MUNICIPAL POLICY RECOMMENDATIONS

Recommendation 1: Develop comprehensive plan guidance.
Recommendation 1: Develop comprehensive plan guidance to provide context for negotiation of EV charging station commitments from developers during the development approval process for new development and redevelopment.
Resources: Electric Vehicle Infrastructure: Washington State, Fairfax County, San Francisco, Snohomish County
Recommendation 2: Amend zoning ordinance to support EV deployment .
Recommendation 2a: Amend zoning ordinance to support EV deployment.
Recommendation 2b: Amend all zones except conservation areas to allow for EV charging as an accessory, conditional, or principal use.
Recommendation 2c: Allow EV battery exchanges at gas stations within one mile of highways.
Resource(s): Washington State (below), Fairfax County, San Francisco, San Diego, City of Ferndale, Massachusetts, Snohomish County
Recommendation 3: Establish design criteria to address ADA accessibility, safety, and theft deterrence.
Recommendation 3a: 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. Note: ADA compliance may be met by requiring attendant assistance.
Recommendation 3b: Follow examples such as the *Advanced Energy Charging Installation Handbook.* http://www.advancedenergy.org/transportation/evse/Charging%20Handbook.pdf

Resources: Washington State (below), Fairfax County, Kane County (below), Advanced Energy Charging Installation Handbook, ECOtality Report, EV Charging for Persons with Disabilities by Sustainable Transportation Strategies
Reommendation 4:: Establish guidelines for integrating EV infrastructure with public streets.
Recommendation 4a: Establish guidelines addressing a. Preferred locations—at either end of a row of spaces or near a power source b. Work around trees and other infrastructure
Recommendation 4b: Synchronize with current street parking time limits at each location if possible. Allow non-EVs to park during certain hours if desired.
Recommendation 4c: Follow the *Advanced Energy Charging Installation Handbook* http://www.advancedenergy.org/transportation/evse/Charging%20Handbook.pdf
Recommendation 5: Standardize signage for EV charging stations.
Recommendation 5a: Standards should address height, bollards, lighting, security such as cameras and other deterrence devices, and difficulties with nonretracting cords.
Recommendation 5b: Develop standard signage for public charging stations on the basis of the Federal Housing Administration's *Manual for Uniform Traffic Control Devices.*
Recommendation 5c: Use green paint to delineate EV charging spaces.
Recommendation 5d: Standardize and simplify permit process and standards throughout the region.
Recommendation 5e: Support utility efforts to integrate EVs into the electric grid.
Resource: Kane County, Illinois, FHA's Manual for Uniform Traffic Control Devices, Washington State

Ancillary Considerations

- Identifying and addressing other restrictions inhibiting EV infrastructure from moving forward.
- Many places would need an "electrical" permit, not a specific "charging" one—may not actually incorporate needed safety features or ADA requirements.
- Where the standards and design guidelines would reside in different states (e.g., design guidelines would not be incorporated in zoning in Virginia).
- The District of Columbia already has a rulemaking for District Department of Transportation streets but needs one for private interests on streets.
- Fees and revenue vary by jurisdiction—Maryland can charge money for space but not electricity. In Virginia, EV charging service providers may charge a fee for EV charging services 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.[35]
- Jurisdictions differ in control of on-street parking.
- One concern is how to recoup lost gas tax revenue.

[35] VA House Bill 2105 (2011) and Virginia Code §56-1.2 and 56-232.2)

INSPECTIONS & PERMITTING RECOMMENDATIONS

Recommendation 1: Ensure that government permitting requirements provide a pathway to expeditious charging installations.
Recommendation 1a: Develop a rapid (online and in-person) permitting application process with same-day to two to three business day turnaround times for public and private charging installations.
Recommendation 1b: Develop guidance and a checklist for installers of nongovernmental entities seeking permitting for on-street public charging.
Recommendation 1c: Develop guidance and checklist for installers of governmental entities seeking permitting for on-street public charging.
Resource(s): Charging Station Installation Handbook for Electrical Contractors and Inspectors, Advanced Energy
Recommendation 2: Streamline the permitting process for simple residential installations.
Recommendation 2a: Develop streamlined inspection process with a two to three business day turnaround time for public, nonconstruction and private (residential) charging installations.
Recommendation 2b: Develop a streamlined process, waiving certain requirements (such as producing plans and drawings) for simple residential installations.
Recommendation 2c: Update and enhance building codes and fast-track approval to encourage multiunit dwellings retrofitting.
Recommendation 3: Ensure that government permitting requirements provide a pathway to expeditious charging installations.
Recommendation 3: Develop a consistent set of permitting and inspection procedures and checklists for entities seeking permitting on the basis of three main EV charging scenarios:

a. *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.)

b. *Level 2 (208/240V, 40 amps, single phase):* Residential and commercial charging

c. *Level 3/DC fast charge (480V, 90 amps, 3-phase):* Commercial, parking garages and lots charging

Resource(s): Charging Station Installation Handbook for Electrical Contractors and Inspectors, Advanced Energy

Mecklenburg County, NC Code Enforcement: 14 Years of Change

Recommendation 4: Ensure that government permitting requirements provide a pathway to expeditious charging installations.

Recommendation 4a: Develop a one-time fee according to the three main EV charging installations scenarios, The fee should include all applicable fees combined for the permit and inspection processes. (see Recommendation 3a).

Recommendation 5: Integrate on-street public charging infrastructure with street design while ensuring safety.

Recommendation 5a: Communities/neighborhoods and business improvement districts should develop EV infrastructure design plans that blend in with the surrounding area. The plans should address location and design criteria, as well as ancillary safety issues (retractable cords, lighting, signage, ADA accessibility, etc).

Resources: 2010 ADA Standards for Accessible Design, Department of Justice

Electric Vehicle Infrastructure: A Guide for Local Governments in Washington State, State of Washington Department of Commerce

Lessons Learned - EV Project: Accessibility at Public EV Charging Stations, ECOtality

EV Charging For Persons with Disabilities, Sustainable Transportation Strategies
Recommendation 6: Coordinate with local utility.
Recommendation 6a: All new electrical permit applications should include a field noting whether the facility will include EV charging, and if so, the voltage and amperage.
Recommendation 6b: Government permitting and inspections office should provide location and all relevant EV charging information to the local electric utility.

Section 5

Electric Utility Policy

Growing electric vehicle (EV) adoption poses two distinct 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, key regulatory issues and concerns are presented, along with actions that have been taken in Maryland, Virginia, and the District of Columbia to address those concerns. Then issues that will be of concern in the future are presented, and finally, the policy recommendations that emerged from this analysis are listed.

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 chances 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 and local policies on appliance energy efficiency standards and building efficiency codes will help to 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, non-profit, and local government stakeholders, is helping fulfill this role in Washington, D.C. and a number of states across the country. The project releases quarterly reports on charging usage at residential and public stations ECOtality's project

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 manunfacturers 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 to impact 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.

In accordance with legislation passed in the 2011 session of the Maryland General Assembly, Governor Martin O'Malley has 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.[36] 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. 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 should be offered.

[36] 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

Key Policy Issues and Current Status

Unless otherwise noted, the issues discussed below pertain to commercial EV charging stations, not residential charging.

Regulation as a Public Utility

One could interpret some state public utility regulations as applying to EV charging service providers. If an EV charging station were 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.

State Regulatory Status

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.[37]

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.

[37] Maryland General Assembly. Senate. Public Utilities – Electric Vehicle Users and Charging Stations – Exclusions. H.B. 1280, 2012 Session. http://mlis.state.md.us/2012rs/billfile/hb1280.htm

District of Columbia. In the District of Columbia, the Public Service Commission will resolve this policy question in its ongoing EVs case.

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 are determined to be in the business of reselling electricity, EV charging stations would need to be licensed by the state public utility commission.

State Regulatory Status

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.

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.

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 most EV charging is done at home. 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.

State Regulatory Status

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.

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 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.

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.

State Program Status

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.

Virgina. 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 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 offers time-of-use pricing for the entire home, including the vehicle, using a single whole-house meter.

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 reinstituting an EV pilot rate.

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

The exent 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.

State Program Status

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.

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 are 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.

Table 5.1 contains a listing of the current laws and regulations in Maryland, Virginia, and the District of Columbia that address the issues raised in this section.

Table 5.1

Overview of State Laws and Regulations Related to EVSE

	Maryland	**District of Columbia**	**Virginia**
Sale of Electricity for EV	Only electric suppliers licensed by the SSC can sell electricity. 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 (H.B.	Only retail suppliers licensed by the PSC can sell electricity. The DC PSC is considering regulatory treatment of EVs and EVCSs owners in Formal Case #1096. The DC Council is considering a bill that would exempt EV charging station providers from public utility regulation.	2011 legislation that passed the VA General Assembly deems EV charging service providers not to be engaged in the resale of electricity, provided that they purchase the 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. The law deems the provision of EV charging

	1280 and S.B. 997).	(Energy Innovation and Savings Amendment Act of 2012).	services to be a permitted utility activity, but it exempts EV charging service providers from being regulated as public utilities. (House Bill 2105, 2011, and Virginia Code 56-1.2 and 56-232.2)
Release of Records	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 (H.B. 1279 and S.B. 998).	Has not been addressed.	This issue will be addressed as part of DOE's EV Readiness Grant awarded to the Greater Richmond Region.
Rates/Tariffs	Pepco offers an EV rate for commercial customers under Schedule EV. The PSC Rate Case 9261 established a working group to consider rate-based incentives, and pilot programs.	No special rate for EV. PSC Case has been opened (Case #1096).	Dominion EV Rate Pilot was approved by the VA SCC in July and became effective in October. Offers two rate options specifically designed for customers with EVs: (1) 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. (Link)

Recommendations

Top Priority

Recommendation 1: Notify utility of EVSE installation.

Recommendation: Notify utilities in advance about locations of new Level 2 or DC fast charge charging stations.

Recommendation: A statewide public charging station registry should be developed.

Recommendation: All new electrical permits should include a field noting whether the permit includes EV charging and if so, its voltage and amperage. If the field is checked on the permit, the information should be shared with the local utility.

High Priority

Recommendation 2: Clarify regulatory status of EV charging service providers.

Recommendation: Nonutility EV charging service providers should not be regulated as public utilities or electricity suppliers.

Recommendation: EVSE providers are offering a service, not just electricity, so that service should not be considered 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 3: Prepare for greater deployment of DC fast charging.

Recommendation: Notify utilities in advance about locations of DC fast charge charging stations.

Recommendation: Encourage local governments and fleets to monitor SAE standards on DC fast charging connections and to consider waiting for standards to be adopted before making large investments in DC fast charging infrastructure.

Recommendation 4: Promote utility EV education programs.

Recommendation: Encourage participation in or partnership with utility education programs.

Recommendation: Research the possibility of joint programs to expand and improve their outreach and impact.

Recommendation 5: Provide EV charging cost information at public charging stations.

Recommendation: There should be no prohibition against charging service providers that do not charge for their service.

Recommendation: Information about the hourly and/or total cost of the charging service should be provided at the EV charging station, subject to applicable state and local laws and regulations.

Medium to Low Priority

Recommendation 6: Reduce upstream emissions associated with EV charging.

Recommendation: State and local governments should continue to support clean and renewable energy programs that reduce the emissions intensity of electricity production in the region and therby decrease the estimated indirect upstream emissions associated with EV use.

Recommendation 7: Monitor the development of "smart" EVSE.

Recommendation: Do not interfere with the market; do not prohibit the sale of EVSEs that are not smart-grid-ready.

Recommendation: Communications protocols for EVSE should be developed, likely by standards development organizations working with federal government entities.

Recommendation 8: Allow a variety of metering and billing scenarios.

Recommendation: Do not prevent or prohibit the use of second meters, since in some instances they may provide the most cost-effective option.

Recommendation: Encourage regulatory flexibility to allow multiple technological solutions to metering and billing issues.

Recommendation 9: Enable and promote utility EV pilot programs.

Recommendation: Encourage customers who have purchased an EV or are considering the purchase of an EV to participate in utility pilot programs.

Recommendation: Support state regulatory approval of such programs, including the establishment of EV-specific tariffs for residential, commercial, industrial, and governmental customers.

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, the EV public fleets now in use in the metropolitan Washington region, and the current and planned use of EVs in private fleets in the region. Finally, recommendations related to promoting EV fleets are presented.

EPAct 92 AFV Acquisition Requirements

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

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

AFVs include flex-fuel vehicles (FFVs), compressed natural gas (CNG) or propane (LPG) dedicated or bi-fuel vehicles, 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 (EISA) proposes a credit allocation for hybrid, plug-in hybrid, fuel cell and neighborhood electric vehicles. The comment period on the notice of proposed rulemaking (NOPR) ended December 31, 2011. Preparation of the final rule is underway. Current AFV acquisition requirements under EPAct 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

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[38] 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.

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

The Electrification Coalition prepared a report, *Fleet Electrification Roadmap (2010)*,[39] which presents six major advantages of EVs over internal combustion vehicles for commercial and government fleet use. The advantages include the lower total cost of ownership (capital plus operating costs), route predictability, higher vehicle utilization rates, greater use of central parking and fueling facility, lower maintenance and service costs, and lower electricity rates.

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

[38] Greater Washington Regional Clean Cities Coalition. *Clean Cities 2011 Annual Report*. Spring 2012.
[39] Electrification Coalition. *Fleet Electrification Roadmap*. November 2010. Available at http://www.electrificationcoalition.org/sites/default/files/EC-Fleet-Roadmap-screen.pdf

used efficiently. The analysis concludes that cost competiveness increased over time for hybrid electric and plug-in hybrid electric vehicles when compared with conventional internal combustion vehicles when fleet operating conditions are considered when the battery is sized.

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 a 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 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 electric vehicles. Through GSA Federal Vehicle Standards, GSA customers can acquire a variety of EVs and EVSE brands/models, installation services, and ancillary services.

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. 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 electric vehicles.

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

Recommendations

Recommendation 1: 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)

Recommendation 2: Establish payment for EV charging with credit and debit cards, and ensure that EV charging stations can be accessed by common fleet cards such as Voyager and Wright Express,.

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Recommendation 3: Public and private fleets managers should consider the total cost value of ownership such as lower fuel and maintenance costs as well as nonmonetary benefits

Recommendation 4: Encourage sharing and alternate EV charging station arrangements.

a. Fleets that operate in large geographic areas are encouraged 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 with escalating pricing mechanisms.
c. Utility and private firms should consider installing EVSE networks with monthly subscription rates for unlimited charging (e.g., NRG Energy).

Recommendation 5: Promote cooperative purchasing.

Governmental entities should utilize the General Services Administration, COG, or other cooperative procurement agreements and mechanisms to reduce acquisition costs and to advance adoption of EVs.

Recommendation 6: Influence public policy.

Public fleets should become more engaged in the regulatory treatment of EV charging stations—such as supporting model ordinances—as an effective way to influence energy policy.

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Section 7

Outreach and Education

The current information gap between electric vehicles 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.[40] To set the stage for EV marketplace success in the National Capital Region, regional partners involved in the Metropolitan COG Electric Vehicle Workgroups 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.

EV Education Target Audiences

Consumers. Ultimately, marketplace success is decided by consumers. Messaging should reflect how easy it is to own a 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/condo 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 a EV may need information on EV fleet capabilities appropriate for their needs.

[40] 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

Service Industry. This target audience incorporates total vehicle service, including 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 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 electric vehicle (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 is 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. Electric vehicles 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 typically cover the following subject content:

- 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.[41] The NFPA 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 home computers or on an iPhone. 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 curriculum. 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. A webinar course is also currently offered, reviewing 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*

[41] National Fire Protection Association. *Electric Vehicle Safety Training.* Available at http://www.evsafetytraining.org/about-us.aspx#

Voltage Batteries.[42] 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,[43] the emergency response community,[44] and tow truck operators and storage facilities.[45]

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.

National Training Centers are postsecondary education and training organizations that provide instruction and a demonstrated commitment to move toward providing instruction in alternative fuels, alternative fuel vehicles, advanced technology vehicles, and related technologies. Associate Training Centers include high schools and 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

[42] National Highway Traffic Safety Administration. *Interim Guidance for Electric and Hybrid-Electric Vehicles Equipped with High Voltage Batteries.* January 2012. Available at http://www.evsafetytraining.org/Resources/~/media/Files/PDFs/NHTSA%20Interim_Guidance_ELECTRIC%20and%20HYBRID%20VEHICLES.pdf

[43] National Highway Traffic Safety Administration. *Interim Guidance for Electric and Hybrid-Electric Vehicles Equipped with High Voltage Batteries.* January 2012. Available at http://www.evsafetytraining.org/Resources/~/media/Files/PDFs/NHTSA%20Interim_Guidance_Consumers.pdf

[44] 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.evsafetytraining.org/Resources/~/media/Files/PDFs/NHTSA%20Interim_Guidance_Emergency%20Response.pdf

[45] 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.evsafetytraining.org/Resources/~/media/Files/PDFs/NHTSA%20Interim_Guidance_Tow.pdf

- 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[46]

- 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

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: Identify and promote EV education and outreach resources.

A plethora of information exists on the Internet regarding EVs. The main resources that address the needs of the target audiences mentioned above should be identified and shared with regional partners on a continuous basis. This would help ensure that reliable and consistent information is being provided to target audiences across the region. An initial set of resources is identified below. Updating resources on a continual basis would allow for incorporation of education resources that will become available in the future. For instance, the Center for Climate and Energy Solutions (C2ES)—the Georgetown Climate Center working with the Transportation

[46] Electric Vehicle Safety Training. *Chevrolet.* Available at http://www.evsafetytraining.org/Resources/Auto-Manufacturer-Resources/Chevrolet.aspx

Climate Initiative—plans to develop education strategies that will include resources that address some of the target audience needs identified above. Additional local resources can be added as local governments move forward with developing policies and standards for EV charging stations and other regional partners move forward with their outreach efforts.

National Resources

- www.goelectricdrive.com is sponsored by the Electric Drive Transportation Association. Also, see their Facebook Page, Twitter Feed, and YouTube Page.
- 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

Recommendation 2: Continue to engage regional EV partners to encourage collaboration, share experiences, and identify new best practices and resources.

COG convened regional partners in EV workgroups to guide the development of the EV readiness strategy for the National Capital Region. Regional partners should continue to convene to help facilitate implementation of the strategy, share resources, and collaborate on initiatives and events.

Recommendation 3: Promote awareness of the emerging EV industry training and curriculums.

The National Alternative Fuels Training Consortium, located at West Virginia University, offers EV courses, workshops, and online training for a variety of audiences, including fire fighters, auto technicians, and tow truck drivers. Associate Training Centers that offer the coursework more locally include the Community College of Baltimore County; the Electric Drive Vehicle Transport Association in Washington, DC; and Northern Virginia Community College. Regional partners should encourage service industry representatives to participate in the courses that are offered. In addition, the National Alternative Fuels Training Consortium is developing a curriculum for high school instructors. Partners should encourage high school automotive programs to participate in available training. High school instructors should be made aware of other available curriculum, resources, and case studies such as

- The Advanced Electric Drive Toolkit, which features videos and power point 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 D.C.
- 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.

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.

Municipal Policy

Municipalities 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 and zoning codes should to address issues such as ADA accessibility, safety, integration with public streets, and signage.

Inspections and Permitting

Municipalities 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 curriculums offered in the region.

Below is a summary of recommendations related to each of these elements of the metropolitan Washington region's preparation for EV readiness.

EV AND EVSE DEPLOYMENT PLANNING

Recommendation 1: Promote EVSE siting in strategic locations and monitor EV use and EVSE installation.

g. Charging will take place primarily at home, secondarily at the workplace, and third at other destinations. Taking that into account, charging station siting should be driven by the market and consumer needs. EV owners with garages or driveways can benefit from streamlining of permitting and educational resources. Multifamily housing and urban dwellers are a special case because they lack of access to a garage or to an electrical outlet.

h. Many workplace locations with parking such as office parks, surface parking lots, hotels, convention centers, hospitals, airports, fleet depots, and Park & Ride facilities are feasible locations for charging stations since vehicles are parked there for 6–10 hours.[47]
i. Other destination parking includes shopping centers and transportation hubs. For recreational destinations, suggested charging locations 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, and gas stations located at rest stops.
j. Public charging could be located at city halls, libraries and on-street.
k. EV car sharing and rental programs provide additional opportunities for charging locations.
l. Benchmark EV sales and use in the metropolitan Washington region and compare with other cities to identify additional needs or barriers

Recommendation 2: Equip new commercial, multifamily residential and major public construction and redevelopment in advance with a feasible level of inexpensive technology to reduce future installation expense.

d. Provide the physical space for transformer capacity to allow for the future installation of full-lot electrification.
e. The electrical room should have physical space to allow future installation of a switchboard and capacity for submetering.
f. Parking area construction should include conduit bank and conduit between the facility's electrical room and the spaces needed for future electrification.

Recommendation 3: Address multifamily residential EV charging challenges.

f. Follow best practices and heed lessons learned in pilot programs from other U.S. cities.

[47] Locations such as Park & Ride and airports may necessitate EVSE valet service since cars are parked for longer periods of time.

g. Connect property owners and managers, home owners associations, and condominium associations with educational resources relating to EVSE implementation.
h. Requirements should depend on whether the units have or manage a parking facility.
i. Managers could incorporate EV into the parking ratio.
j. Car sharing and charger sharing can help meet the needs of multifamily building residents.

Recommendation 4: Facilitate workplace charging.

d. Identify prime workplace charging locations on the basis of commuting patterns, survey of fleet needs, and EV charger installation plans.
e. Through COG Commuter Connections, the Apartment and Office Building Association, and other associations, connect employers and property managers with EVSE installation procedures and resources.
f. Partnerships can be developed between corporate offices and EV dealerships/service providers on the basis of new revenue models to deploy fleet EVs and charging stations.

Recommendation 5: Develop tourist market opportunities.

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

Recommendation 6: Develop public EV infrastructure investment.

c. 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 electric car.
d. Municipalities should lay down a conduit for future on-street EV parking during right-of-way redevelopment.
e. Companies could sponsor charging stations.
f. Governments can grant special use permits for parking spaces. Develop guidance for nongovernmental entities seeking permitting of on-street charging.

g. Certify a meter in the charging station itself instead of including a separate utility meter.

Recommendation 7: Increase access to public charging stations for Levels 1 and 2.

d. EV owners suggest that municipalities issue EV Charging Passes at low monthly charge that allows EV owners to use a network of simple 110V charging outlets.
e. Level 1 stations should be in low-turnover locations such as the home or workplace. Level 2 stations should be in high-turnover locations or in locations with valet service or with one load control for multiple spots.
f. For Level 2, allow owners the ability to control turnover, such as raising the rate after two hours.

MUNICIPAL POLICY

Recommendation 1: Develop comprehensive plan guidance.

a. Develop comprehensive plan guidance to provide context for negotiation of EV charging station commitments from developers during the development approval process for new development and redevelopment.

Recommendation 2: 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: Establish design criteria to address ADA accessibility, safety, and theft deterrence.

a. For public and commercial charging stations, establish design standards (including cost information) to address ADA accessibility, space dimensions, tripping hazards, electrical hazards, and theft deterrence .

b. Standards should address height, bollards, lighting, security such as cameras and other deterrence devices, and difficulties with nonretracting cords.

c. Follow examples such as those in the *Advanced Energy Charging Installation Handbook*.

Recommendation 4: Establish guidelines for integrating EV infrastructure with public streets.

a. Establish guidelines addressing the following:

   i. Preferred locations—at either end of a row of spaces and near a power source.

   ii. Work around trees and other infrastructure.

b. Synchronize with current street parking time limits at each location if possible; allow non-EVs to park during certain hours if desired.

c. Follow guidance in the *Advanced Energy Charging Installation Handbook.*

Recommendation 5: Standardize signage for EV charging stations.

a. Develop standard signage for public charging stations on the basis of the Federal Housing Administration's *Manual for Uniform Traffic Control Devices.*

b. Use green paint to delineate EV charging spaces.

c. Standardize and simplify the permit process and standards throughout the region.

d. Support utility efforts to integrate EVs into the electric grid.

Recommendation 6: Partner with utilities and EV service companies around grid issues, revenue, installation requirements, and creation of a subscription network.

INSPECTIONS and PERMITTING RECOMMENDATIONS

Recommendation 1: Ensure that government permitting requirements provide a pathway to expeditious charging installations.

a. Develop a rapid (online and in-person) permitting application process with same-day to two-to-three-business-day turnaround times for public and private charging installations.

b. Develop a streamlined inspection process with a two-to-three-business-day turnaround time for public, nonconstruction, and private (residential) charging installations.

Recommendation 2: Streamline the permitting process for simple residential 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/enhance building codes and fast-track approval to encourage multiunit dwelling retrofitting.

Recommendation 3: Develop a consistent set of permitting procedures for each EV charging scenario.

a. Develop a consistent set of permitting and inspection procedures and checklists for entities seeking permitting based on three main EV charging scenarios:

   i. *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)

   ii. *Level 2 (208/240V, 40 amps, single phase):* Residential and commercial charging

   iii. *DC Fast Charge (480V, 90 amps, 3-phase):* Commercial, parking garages, and lots charging

b. Develop guidance and a checklist for installers seeking permitting for on-street public charging. Separate guidance may be needed for governmental and nongovernmental entities.

c. Develop a one-time fee according to each EV charging installation scenario. The fee should include all applicable fees combined for the permit and inspection processes.

Recommendation 4: Integrate on-street public charging infrastructure with street design while ensuring safety.(see Municipal Policy #4)

a. Communities, neighborhoods, and business improvement districts should develop EV infrastructure design plans that blend in with the surrounding area. The plans should address location and design criteria, as well as ancillary safety issues (retractable cords, lighting, signage, ADA accessibility, etc).

Recommendation 5: Coordinate with the local utility (See Utility #1)

a. All new electrical permit applications should include a field noting whether the facility will include EV charging, and if so, the voltage and amperage.

b. The government permitting and inspections office should provide the location and all relevant EV charging information to the local electric utility.

UTILITY PLANNING AND POLICY

Recommendation 1: Notify utilities of EVSE installation.

a. Notify utilities in advance about locations of new Level 2 or DC fast charge charging stations.

b. A statewide public charging station registry should be developed.

c. All new electrical permits should include a field noting whether the permit includes EV charging and if so, its voltage and amperage. If the field is checked on the permit, the information should be shared with the local utility.

Recommendation 2: Clarify regulatory status of EV charging service providers.

a. Nonutility EV charging service providers should not be regulated as public utilities or electricity suppliers.

b. EVSE providers offer a service, not just electricity, so their business should not be considered a "sale for resale" or the "retail sale of electricity" subject to state/local electric provider regulations, given that they meet any existing conditions in state law.

c. Local governments should work with utilities to overcome barriers to renewable EV charging and identify opportunities to modify existing policy to further enable EV charging from renewable sources, while respecting state laws governing electric utility regulation and utility franchise rights and accounting for the terms of contractual agreements between electric utilities and governmental entities.

Recommendation 3: Prepare for greater deployment of DC fast charging.

a. Notify utilities in advance about locations of DC fast charge charging stations.
b. Local governments and fleets should monitor SAE standards on DC fast charging connections and consider waiting for standards to be adopted before making large investments in DC fast charging infrastructure.

Recommendation 4: Promote utility 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.

Recommendation 5: Provide EV charging cost information at public charging stations.

Recommendation: Information about the hourly and/or total cost of the charging service should be provided at the EV charging station.

Recommendation 6: Monitor development of the "smart" EVSE market.

a. Do not interfere with the market; do not prohibit the sale of EVSE that is not smart-grid-ready.
b. Communications protocols for EVSE should be developed, likely by standards development organizations working with federal government entities.

Recommendation 7: Allow a variety of metering and billing scenarios.

a. Do not prevent or prohibit the use of second meters, since they sometimes provide the most cost-effective option.
b. Encourage regulatory flexibility to allow multiple technological solutions to metering and billing issues.
c. Do not prohibit charging service providers from offering their service at no charge.

Recommendation 8: Enable and promote utility EV rate 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.

VEHICLE FLEETS

Recommendation 1: Reduce the cost and increase the utilization of EVs.

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 to expand HOV access.

c. Create clean renewable energy bonds for fleet vehicle infrastructure financing for fleets with more than 10 vehicles.
d. Expand the tax credit for light, medium, and heavy duty vehicles.
e. Support the extension of existing federal tax credits for EV infrastructure through 2018.
f. Increase advanced battery and related research and development (R&D).

Recommendation 2: Establish uniform payment mechanisms at charging stations.

a. Establish payment for EV charging stations with credit and debit cards and ensure that EV charging stations can be accessed by common fleet credit cards such as Voyager and Wright Express.

Recommendation 3: Educate public and private fleet managers about the total cost value of ownership such as lower fuel and maintenance costs in addition to nonmonetary benefits.

Recommendation 4: Encourage sharing and alternate EV charging station arrangements.

a. Fleets that operate in large geographic areas are encouraged 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 with escalating pricing mechanisms.
c. Utility and private firms should consider installing EVSE networks with monthly subscription rates for unlimited charging (e.g., NRG Energy).

Recommendation 5: Promote cooperative purchasing of EVs for fleets.

a. Governmental entities should utilize the General Services Administration, COG, or other cooperative procurement agreements and mechanisms to reduce acquisition costs and increase the availability of vehicles.

Recommendation 6: Influence public policy.

a. Public fleet managers should become more engaged in the regulatory treatment of EV charging stations—for example, by supporting model ordinances—as an effective way to influence energy policy.

OUTREACH AND EDUCATION

Recommendation 1: Identify and promote EV education and outreach resources.

a. The main resources that address the needs of target audiences should be identified and shared with regional partners on a continuous basis.
b. Additional local resources can be added as local governments move forward with developing policies and standards for EV charging stations and other regional partners move forward with their outreach efforts.
c. Encourage participation in or partnership with utility education programs.

Recommendation 2: Continue to engage regional EV partners to encourage collaboration, share experiences, and identify new best practices and resources.

a. COG convened regional partners in EV workgroups to guide the development of the EV readiness strategy for the metropolitan Washington region. Regional partners should continue to convene to help facilitate the implementation of the strategy, share resources, and collaborate on initiatives and events.

Recommendation 3: Promote awareness of the emerging EV industry with training and curricula.

a. Partners should encourage high school automotive programs to participate in training offered, when available.
b. High school instructors should be made aware of other available curriculums, resources, and case studies.