READY to ROLL!

Southeastern Pennsylvania's Regional Electric Vehicle Action Plan

Volume I: Planning and Policy Recommendations

June 2013

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

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Volume II of *Ready to Roll! Southeastern Pennsylvania's Regional EV Action Plan* provides an in-depth overview of electric vehicle technology, detailed analysis of projected electric vehicle sales and usage in southeastern Pennsylvania, as well as further discussion of the policies and recommendations covered in Volume I. Volume II also contains a detailed bibliography and Appendices A through L. Volume II is available for download at no charge via www.dvrpc.org.

Executive Summary

On-road internal combustion engine (ICE) vehicles are responsible for nearly one-third of energy use and one-quarter of greenhouse gas (GHG) emissions in southeastern Pennsylvania.[1] Electric vehicles (EVs), including plug-in hybrid electric vehicles (PHEVs) and all-electric vehicles (AEVs), present an opportunity to serve a significant portion of the region's mobility needs while simultaneously reducing energy use, petroleum dependence, fueling costs, and GHG emissions. As a national leader in EV readiness, the region can serve as an example for other efforts around the country.

Ready to Roll! Southeastern Pennsylvania's Regional EV Action Plan (*Ready to Roll!*) is a comprehensive, regionally coordinated approach to introducing EVs and electric vehicle supply equipment (EVSE) into the five counties of southeastern Pennsylvania (Bucks, Chester, Delaware, Montgomery, and Philadelphia). This plan is the product of a partnership between the Delaware Valley Regional Planning Commission (DVRPC), the City of Philadelphia, PECO Energy Company (PECO; the region's electricity provider), and Greater Philadelphia Clean Cities (GPCC). Additionally, ICF International provided assistance to DVRPC with the preparation of this plan. The plan incorporates feedback from key regional stakeholders, national best practices, and research to assess the southeastern Pennsylvania EV market, identify current market barriers, and develop strategies to facilitate vehicle and infrastructure deployment.

Ready to Roll! is presented in two volumes, and is accompanied by an online information clearinghouse, containing links to additional resources. The first volume includes the regional readiness plan, comprised of:

- Projections for EV deployment by individuals and fleets;
- Projections for residential, workplace, private access, and public access EVSE deployment;
- Projected opportunities for EVSE integration with the smart grid;
- Estimates for potential costs associated with EVs and EVSE, as well as funding opportunities to offset these costs;
- Barriers to EV and EVSE deployment in the region and recommendations to overcome these barriers; and
- An overview of stakeholders and partners involved in the preparation of the readiness plan, including a discussion of the roles and responsibilities of each stakeholder.

The second volume provides an in-depth analysis of a variety of EV and EVSE issues, including:

- EV Overview. This section provides an overview of EV architecture and characteristics, battery technology, and ownership costs. The section also reviews the regulatory landscape and vehicle technology trends to highlight competitive alternatives to EVs in the near, mid, and long term, such as the use of fuel-saving technologies in ICE vehicles and the opportunities presented by other alternative fuels.
- Charging Technology Overview. This section provides an overview of the EV charging process and types of EVSE available. This section also discusses strategies and technologies that utilities can use to plan for the additional electricity demand that could come with EV charging.
- EV Consumer Overview. This section summarizes EV consumer demographics and behaviors based on survey data and discussions with EV manufacturers and researchers. This research indicates early EV adopters tend to earn above average income, tend to own homes in urban or suburban areas, tend to be male, and often report previous hybrid electric vehicle (HEV) ownership.

[1] Delaware Valley Regional Planning Commission. "Regional Greenhouse Gas Emissions Inventory." December 2010. Accessed June 2013, http://www.dvrpc.org/reports/09038A.pdf.

- EV Market Segment Overview. This section summarizes the major market segments for EV deployment, including personal vehicles, commercial fleets, and government fleets. It also presents the detailed findings from a survey of local fleets in southeastern Pennsylvania.
- EV and EVSE Deployment in Southeastern Pennsylvania. This section provides information about current and future EVs available in the United States and in southeastern Pennsylvania. The project team analyzed household profiles and current hybrid and electric vehicle ownership patterns to predict the geography of EV adoption and used employment density, location of major attractions, high volume roadways, and other indicators to identify likely areas for public and workplace EVSE. The project team estimates that EV sales will comprise about 2.6 percent of all new vehicle sales in southeastern Pennsylvania by 2020.

  The section also presents an analysis of EV ownership costs in southeastern Pennsylvania and an overview of incentives to reduce ownership costs.
- EVSE Installation Considerations and Processes. This section outlines the EVSE installation process and analyzes the economics of EVSE acquisition, installation, and operation. This analysis includes a discussion of EVSE costs and considerations in multi-unit dwellings (MUD).
- Regulatory Framework to Facilitate EVSE Deployment. This section provides an overview of tools that communities can use to support regional EV readiness, including building and electrical codes, zoning codes, permitting and inspection processes, parking rules, signage standards, and procurement policies. Although southeastern Pennsylvania comprises a patchwork of regulations and policies, communication and coordination across the region can help to promote a consistent regulatory framework.
- Education, Outreach, and Marketing Plan for Southeastern Pennsylvania. This section presents examples of existing education and outreach efforts designed to engage and inform the wide range of EV stakeholders, including EV consumers, vehicle dealerships, technicians, local officials, utilities, first responders, property managers, and parking garage operators. The section also outlines recommendations for an education, outreach, and marketing campaign to increase demand for EVs in the region.
- Best Practices for Incentives and Programs to Enhance Demand for EVs and EVSE. This section summarizes the wide range of federal, state, and local incentives that have been established throughout the United States to support deployment of EVs, as well as best practices for local governments interested in developing such incentives. This section also summarizes existing incentives and programs in southeastern Pennsylvania, including those offered by the federal government and state, local, and private entities.
- Utility Policies and Plans to Accommodate EVs. This section provides an overview of the Pennsylvania electricity market and discusses PECO's involvement in EV deployment and grid preparation in southeastern Pennsylvania. The section also presents current research on expected impact of EVs on the electrical grid and strategies to minimize impacts. Although PECO has determined that its current distribution system has adequate capacity based on forecast EV adoption scenarios, the utility has plans or is currently working to implement some of these strategies.
- Appendices. Appendices A through L provide additional detail and are referenced in the body of both volumes of the document.

DVRPC has developed an online clearinghouse with information for the general public, fleet operators, and local governments interested in EVs and EVSE. It covers topic such as costs and benefits of EVs and EVSE, recommendations for deployment, electricity rates for EV customers, and incentives for EVs and EVSE. It also provides a customized cost of ownership calculator for consumers and links to additional resources.

Based on the analyses and technical information presented in Volume I and II, *Ready to Roll!* provides the following recommendations:

Building, Electrical, and Zoning Codes

Plans. To support the adoption of EVSE through local regulations such as zoning and codes, communities should consider preparing and adopting plans that specifically identify EV and EVSE deployment as a community priority. Comprehensive plans, sustainability plans, and dedicated EV readiness plans each have advantages for communities interested in accelerating EV and EVSE deployment. The most appropriate plan will depend on the community's plan adoption timelines, available resources, and political will.

EV Definitions. Consistent EV-related definitions may assist in clarifying the intent and scope of new regulations. Such definitions may also lay the foundation for future EV-related regulations. EV-related definitions should be added to local codes independently or adopted in conjunction with new EV and EVSE regulations. Definitions include the vehicle and all related supply equipment as well as traffic, vehicle, parking, and building codes, and any other items that might relate to EVs and EVSE.

Zoning Code Amendments. Communities should consider three potential ways to amend local zoning codes to support EV and EVSE deployment: add EVSE as a permitted use in some or all zoning districts; require EVSE for specific kinds of land use developments; or provide incentives for developers to include electrical conduit or pre-wiring or install EVSE in new construction. With regard to requiring EVSE, communities should consider setting a minimum numerical or percentage-based requirement for EV parking spaces for each development type. For incentives, communities should consider counting EV parking spaces toward minimum requirements or reduce minimum parking space requirements when developers include EVSE installations in their designs. Communities should also consider establishing design criteria for EV parking spaces, including lighting requirements, dimensions, curb clearance, maintenance, and signage.

Installation, Permitting, and Inspection Processes

Electrician Database. Because communities in southeastern Pennsylvania establish their own licensing systems for electricians, local governments may consider developing a database of electricians certified to install EVSE to assist potential and current EV owners.

Checklists. Communities should consider providing EVSE installation and permit application checklists to assist EV owners. An installation checklist may contain information about which type of EVSE will meet customers' needs, whether their existing electrical infrastructure is sufficient, and next steps in terms of permitting and inspection. The permit application checklist might provide a list of items needed for the permit application, as well as a step-by-step walkthrough of the process, along with contact information if EV owners have specific questions. Communities might also provide a checklist for local officials to follow when reviewing an application or inspecting an installation to expedite the process.

Educate Permitting Staff. In early EV deployment stages, each permitting office may only need to train one permitting and inspection official to handle all EVSE permit applications and inspections. However, as projects become more common, communities may consider preparing additional staff members as necessary. Permitting offices should encourage the appropriate staff to attend a training to develop expertise in the EVSE training process.

Inspection Streamlining. Communities should consider implementing a 24-7 system to request inspections to make the process more convenient for applicants. Such a system might use voicemail requests or an online request form. Communities may choose to waive the inspection requirement for simple EVSE installations conducted by trained or experienced electricians. Communities using this approach should rely on a registry of electricians that have passed certain training sessions or may allow electricians to qualify for self-inspection once they have installed a certain number of EVSE projects that pass inspections.

Parking Rules

Parking Ordinances. Communities should consider enacting parking ordinances that establish clear regulations and enforcement policies for EV parking spaces. The ordinance could outline requirements for location, accessibility, use, design, and fees associated with the public parking spaces, including what types of vehicles can park in a space, the duration of time, and charging requirements. Policies should also establish clear enforcement policies defining the consequences of violating those rules. Communities should adopt such a parking ordinance before installing regulatory EVSE signage (described below) to formalize and legitimize regulatory signage and mitigate the risk of people disregarding regulatory signage as unenforceable.

Signage Standards

Signage Consistency. Communities should work with neighboring jurisdictions and the Pennsylvania Department of Transportation (PennDOT) to develop consistent signage that is also consistent with the U.S. Federal Highway Administration Manual on Uniform Traffic Control Devices. Consistent signage reduces confusion about EVSE availability and use requirements.

Way-Finding Signage. Communities should work with neighboring jurisdictions, their county, and PennDOT to develop consistent and adequate signage to guide drivers to publicly accessible EVSE locations.

Procurement Policies

Procurement Requirements. Government fleet purchases have the potential to stimulate the market for a given type of vehicle or fuel. Communities might consider amending current alternative fuel vehicle or low-emission vehicle procurement requirements or creating new policies to support EV deployment in government fleets.

Marketing, Outreach, and Education

Education Partnerships and Speakers' Bureau. Partnering with local organizations can help to expand the reach and effectiveness of outreach, education, and training efforts. Communities might reach out to local stakeholder groups (e.g., electrical unions, business groups, county governments) to request that they include a brief presentation by an EV or EVSE expert on their regular meeting agendas. A speakers' bureau could help to coordinate the presentations. Alternatively, partners could host a training workshop in their venues, which would be familiar and accessible to their constituents. Such partnerships can increase dissemination of EV and EVSE information and reduce the costs associated with outreach.

Electrician and Local Government Training. Communities should consider hosting public EVSE installation training for electricians to increase the availability of qualified electricians. Alternatively, communities might publicize existing courses in the area, such as courses provided by the Electric Vehicle Infrastructure Training Program. Communities might also consider training their permitting and inspection staff to increase the efficiency and effectiveness of permit application reviews and inspections. Communities may do this by providing written procedures for officials to follow when reviewing an application or inspecting an installation. Alternatively, communities might offer dedicated EVSE installation training for officials.

Outreach, Education, and Training Materials. Communities can take advantage of existing media, including online, print, and video resources, to plan outreach, education, and training events and provide informational materials to regional stakeholders.

Community Marketing Materials. Communities that show leadership through EV deployment initiatives may market themselves as forward-looking, sustainable, and health-conscious communities. Such materials may include information about public EVSE, fleets of EVs, and programs that support EV deployment. New residents and tourists may be drawn to destinations with modern amenities and progressive initiatives. Furthermore, such marketing efforts may contribute to resident interest in EV and EVSE.

Incentives and Support

Individual and Fleet Incentives. If resources are available, communities can provide monetary incentives, such as grants or rebates for EV or EVSE purchase. Communities that are not able or choose not to provide financial incentives might consider providing non-monetary incentives for individual consumers, as well as EV taxicab fleets and car rental programs. For example, some communities provide free or convenient parking for EVs. Other communities have implemented taxicab-specific incentives such as head-of-the-line privileges, which allow EV taxicabs to advance to the beginning of the waiting line in a staging area.

Property Manager and Homeowners Associations Support. Communities might consider supporting property managers and homeowners associations (HOAs) to encourage EV and EVSE deployment in MUD scenarios. This is particularly important in southeastern Pennsylvania because many residents live in MUDs with shared parking facilities. Communities may discuss property manager and HOA concerns and coordinate to identify solutions that can be implemented at the local government level.

Public-Private Partnerships. Communities could engage in public-private partnerships to promote EV procurement, EVSE installation, and other services, such as EV carsharing. These partnerships can help to overcome upfront cost barriers to EV and EVSE deployment by pooling public and private resources.

Utility Policies and Plans

Identification of Necessary Infrastructure Upgrades. Local utilities should follow PECO's lead and use the areas of high EV demand developed for this report to identify electrical infrastructure that may need additional or enhanced infrastructure or upgrades.

Alternative Rate Structures. Some utilities use dynamic or time-based pricing to encourage customers to shift their electricity use patterns. For example, utilities might consider time-of-use rates to encourage EV charging during "off-peak" hours. Designing a dynamic pricing strategy requires careful consideration, and utilities will need to revisit any rate structure as EVs become more common to ensure that it continues to achieve the desired goals as market conditions change.

EVSE Installation Notification. Utilities might consider providing a mechanism for fleets and individuals to notify them of new EVSE installations. For example, utilities can encourage entities to notify them of new installations by mobilizing a rebate program. Municipalities can also encourage EV consumers to notify their local utility or require utility notification as part of the permitting process.

Smart Grid Infrastructure Installation and Vehicle-to-Grid Technologies. Smart grid technologies can benefit both EV owners and electricity suppliers. Utilities might consider installing and using smart grid technologies, taking advantage of opportunities to gather granular data on EVSE and vehicle usage patterns and integrate with future vehicle-to-grid technology opportunities. These technologies may allow customers to dictate when to charge vehicles to take advantage of competitive rates and reduce their electricity bills. Smart grid technologies may also assist utilities in anticipating and preventing negative grid impacts associated with EV deployment.

Highway Network

Adequately Fund Transportation Needs. Pennsylvania's roads and bridges are supported primarily by the motor fuel tax on gasoline. While EVs bring many advantages, they do not contribute to the gas tax used to support the roads and bridges they drive on. Pennsylvania needs to fully fund its transportation network, including transit systems, and determine an equitable means to share those costs among all users

These recommendations will assist communities of southeastern Pennsylvania and beyond to educate their constituents about the costs and benefits of EVs and facilitate deployment of EVs and EVSE.

1 Electric Vehicle (EV) Readiness in Southeastern Pennsylvania – Plans and Next Steps

Southeastern Pennsylvania is deeply committed to energy efficiency and conservation efforts. For instance, the City of Philadelphia is devoting significant resources to become the nation's greenest city through its Greenworks Philadelphia program, and the region is following suit. The region's long-range plan, *Connections,* identifies "Building an Energy Efficient Economy" as one of its key regional goals. Philadelphia is the site of the U.S. Department of Energy's (DOE's) Energy Efficient Buildings System Design Hub and the City of Philadelphia is administering the "Retrofit Ramp-up" building energy-efficiency program for southeastern Pennsylvania's five counties. In keeping with its commitment to energy efficiency and conservation efforts, southeastern Pennsylvania is turning its attention to opportunities associated with EV deployment.

On-road internal combustion engine (ICE) vehicles are responsible for nearly one-third of energy use and one-quarter of greenhouse gas (GHG) emissions in southeastern Pennsylvania.[2] EVs, including plug-in hybrid electric vehicles (PHEVs) and all-electric vehicles (AEVs), present a tremendous opportunity to serve a significant portion of the region's mobility needs, while simultaneously reducing energy use, petroleum dependence, fueling costs, and GHG emissions.

Ready to Roll! Southeastern Pennsylvania's Regional EV Action Plan (*Ready to Roll!*) provides a comprehensive, regionally coordinated approach to the introduction of EVs and electric vehicle supply equipment (EVSE) into the five counties of southeastern Pennsylvania (Bucks, Chester, Delaware, Montgomery, and Philadelphia). This plan is the result of a partnership between the Delaware Valley Regional Planning Commission (DVRPC), the City of Philadelphia, PECO Energy (PECO; the region's electricity provider), and Greater Philadelphia Clean Cities (GPCC). Additionally, ICF International provided assistance to DVRPC with the preparation of this plan. The plan incorporates feedback from key regional stakeholders, national best practices, and research to assess the southeastern Pennsylvania EV market and consumers, identify current market barriers, and develop strategies to facilitate vehicle and infrastructure deployment.

Volume I outlines plans and next steps to deploy EVs and EVSE in the region.

[2] DVRPC. "Regional Greenhouse Gas Emissions Inventory." December 2010. Accessed June 2013, http://www.dvrpc.org/reports/09038A.pdf.

1.1 Projected EV Deployment in Southeastern Pennsylvania

1.1.1 Personal vehicle EV deployment

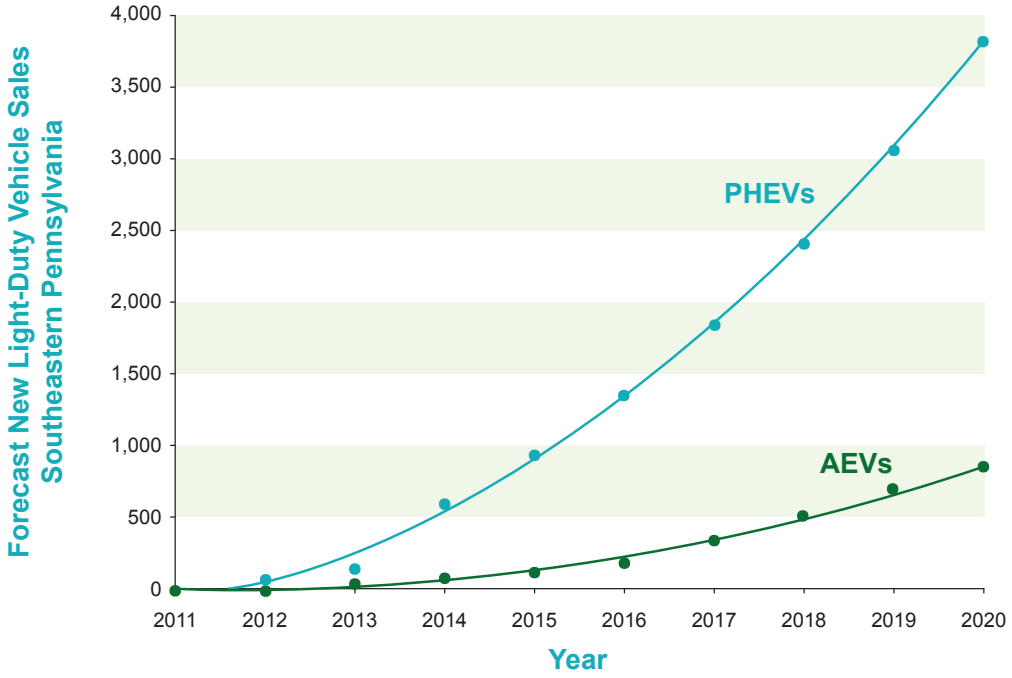
The project team analyzed the following indicators at the census block group level to project the distribution of EV ownership in southeastern Pennsylvania:[3]

- Household income;
- Hybrid electric vehicle (HEV) and current EV ownership;
- Home ownership;
- Dwelling type; and
- Education.

This analysis indicates that annual sales of both PHEVs and AEVs in southeastern Pennsylvania will increase every year over the period of analysis. Regional EV sales are expected to grow from several hundred in 2013 to approximately 1,200 in 2015. EV sales are then expected to rise to over 4,500 in 2020, including just under 4,000 new PHEVs and just under 1,000 new AEVs. EVs are expected to comprise approximately 2.6 percent of total new vehicle sales in the region by 2020. The analysis forecasts that by 2020 there will be about 14,270 PHEVs and 2,900 AEVs deployed in the region, or a total of just over 17,000 EVs. EV ownership projections resulting from this analysis are summarized in Figure 1.

Although EV sales are forecast to be modest out to 2020, it is important to note that the five counties in southeastern Pennsylvania will likely have more EVs than other areas in

Figure 1. **Projected EV Sales in Southeastern Pennsylvania, 2011-2020**



Source: DVRPC, 2013

[3] The American Community Survey (U.S. Census) provided all of these data, except HEV ownership rates, which were derived from data provided by the Pennsylvania Department of Transportation (PennDOT). Because the number of EV owners in the project area is low (120 Chevrolet Volts and 18 Nissan LEAFs as of April 2012), the predictive analysis is inherently subjective. However, it compares with and is supported by existing research regarding the characteristics and motivations of early EV adopters being carried out by other researchers, such as Tal et al, Who Is Buying Electric Cars in California? Exploring Household and Fleet Characteristics of New Plug- In Vehicle Owners. There are 2,979 census block groups in the five Pennsylvania counties of the project area: Bucks, Chester, Delaware, Montgomery, and Philadelphia.

the state. For instance, the study region represents about 22 percent of the light-duty vehicle fleet in Pennsylvania; the project team estimates that the study region currently has 36 percent of the HEVs registered in the entire state. Because HEV ownership has been a good indicator of likely EV ownership to date, the project team has used these data to underscore the importance of readiness in the study region. Furthermore, the project team has purposely developed conservative forecasts. In a more aggressive scenario, the project team forecasts EV sales 20 to 30 percent higher than what is presented in Figure 1 for 2020.

The indicators outlined previously helped the project team develop profiles of EV adopters in the region.

- **Early adopters**: Early adopters of EVs tend to have high income, are most likely to live in and own single-family homes, and have a high likelihood of owning an HEV.
- **Likely adopters**: Likely adopters have similar characteristics to early adopters, but they have slightly lower incomes.
- **Possible adopters**: Possible adopters may hesitate to purchase an EV because of cost or may wait for public EVSE infrastructure to build up before purchasing an EV. These households have varying income levels and live in various types of homes (e.g., single-family or multifamily units).
- **Unlikely adopters**: Unlikely adopters include households with lower incomes, fewer vehicles, and are generally renters. Of all the household profiles, unlikely adopters react most to vehicle pricing, generally as a function of household income.

The project team used the DVRPC household travel survey[4] to quantify the potential consumer market associated with each profile based on information from 2,588 vehicles in the study region. The survey included information on trips taken, allowing researchers to calculate daily vehicle circuit length. Based on an analysis of household profiles, the project team anticipates early adopters will represent approximately four percent of the population in southeastern Pennsylvania, while likely adopters and possible adopters are expected to comprise 12 and 16 percent, respectively.[5]

Likely and possible adopters, who are more price sensitive than early adopters, are expected to drive the secondary phase in deployment (from 2015 to 2020). PHEVs are projected to fulfill the travel needs of drivers in the region better than AEVs and are forecast to outsell AEVs through 2020. This assessment is buoyed by national 2012 sales data for both the Toyota Prius Plug-In and the Chevrolet Volt (both PHEVs), which have outsold the Nissan LEAF (an AEV) by a significant margin.[6]

Additionally, the household travel survey characterized the ability of EVs to meet a given driver's commuting needs. On a typical day, 82 percent of all passenger vehicles in the region travel 40 miles or less, and 97 percent travel 70 miles or less — well within the range of many EVs on the road today.

1.1.2 Fleet EV deployment

Fleet deployment of EVs differs for light-duty and heavy-duty vehicles. Fleet owners interviewed reported that the initial cost and limited vehicle configurations available were significant barriers to EV deployment. DVRPC analyzed vehicle registration data from the Pennsylvania Department of Transportation (PennDOT) and identified 42,559 passenger vehicles in fleets of 10 or more vehicles. Of these, 0.70 percent were HEVs, indicating that there is some potential for EVs. If the relationship between current HEV/EV ownership in fleets and growth in EVs is the same as that in the region as a whole, there would be about 1,700 light-duty EVs in fleets by 2020. DVRPC was not able to estimate the number of heavy-duty fleet vehicles that had potential to be replaced by the limited models of heavy-duty EVs available.

[4] *Transportation for the 21st Century Household Travel Survey: Travel Survey Results for the DVRPC Region*. Prepared for Delaware Valley Regional Planning Commission by NuStats Research & Consulting in association with Cambridge Systematics. May 2001. Available online at: http://www.dvrpc.org/reports/01028.pdf.

[5] For an in-depth discussion of this analysis, see Volume II, Section 5.

[6] Based on ICF analysis of reported EV sales, PHEVs have outsold AEVs since February 2012. As of Q4 2012, PHEVs were outselling AEVs by a ratio of about four to one.

1.2 Projected EVSE Deployment in Southeastern Pennsylvania

Widespread EV deployment in southeastern Pennsylvania will require EV charging infrastructure throughout the region. As such, initiatives to deploy charging infrastructure may benefit from region-wide analysis of demand and usage, as well as regional-level planning for implementation and deployment. The estimates for EVSE deployment in this section are based on a literature review, case studies, and EV deployment projections outlined in the previous section and discussed in more detail in Volume II.

1.2.1 Residential EVSE

The project team determined the areas in southeastern Pennsylvania with the highest potential for EV ownership (see Figure 2). The areas with the highest potential for residential charging station deployment correspond with these same areas. Some residential EV consumers may face challenges with EVSE installation, particularly those living in apartment buildings and other multi-unit dwellings (MUDs), as discussed below.

In mid-2012, ECOtality added Greater Philadelphia to the list of metropolitan areas included in The EV Project. The EV Project, funded by DOE, provided free charging infrastructure and assisted residential participants with the cost of installation. At the date of publication, ECOtality has completed The EV Project in Greater Philadelphia. They have installed 310 residential chargers and 125 commercial chargers through the program.

Residential charging is expected to be the primary mode of charging in southeastern Pennsylvania in the near future. Residential Level 1 EVSE will likely be sufficient for at least 50 percent of PHEV charging, while Level 2 EVSE is expected to be necessary for most residential AEV charging.[7] Therefore, based on EV deployment estimates in southeastern Pennsylvania and expected residential charging infrastructure needs for PHEV and AEV owners, the project team estimates that about 7,100 Level 1 EVSE and 10,000 Level 2 EVSE stations may be deployed in single-family and multi-unit dwellings by 2020.

Level 1 and Level 2 EVSE deployment will depend on how PHEV drivers respond to EVSE installation pricing. Chevrolet maintains that at least 50 percent of Volt drivers opt for Level 1 charging.[8] The Volt has a higher driving range than most other PHEVs: it can achieve nearly 40 miles of all-electric range on a single charge, compared to about 20 miles for the Ford C-MAX Energi, and about 11 miles for the Toyota Prius Plug-in. The project team therefore estimates that the percentage of other PHEV owners opting for Level 1 charging will likely be the same as, if not higher than, for Volt owners.

Solutions for Residential EVSE at MUDs

Residents of MUDs may face barriers to installing EVSE as a result of restrictive facility configurations, equity concerns, and questions about EVSE ownership and cost implications.

DVRPC hosted the "Garage-Free" Electric Vehicle Summit in February 2012 to discuss the various challenges associated with deploying EVSE in MUDs and neighborhoods without dedicated off-street parking. Industry leaders and stakeholders represented at the summit identified barriers and solutions for potential EV owners living in MUDs or other housing not readily amenable to EVSE installation. Three primary topics of conversation included potential solutions to capture the value of existing infrastructure, the viability of neighborhood charging hubs (including discussion of financing and ownership issues), and success stories of EVSE in the northeastern United States. The main outcome from the summit was the importance of education and outreach to homeowner associations and property owners to overcome common barriers to EVSE in MUD settings. For a summary of the discussion and additional conclusions, see Volume II, Appendix D.

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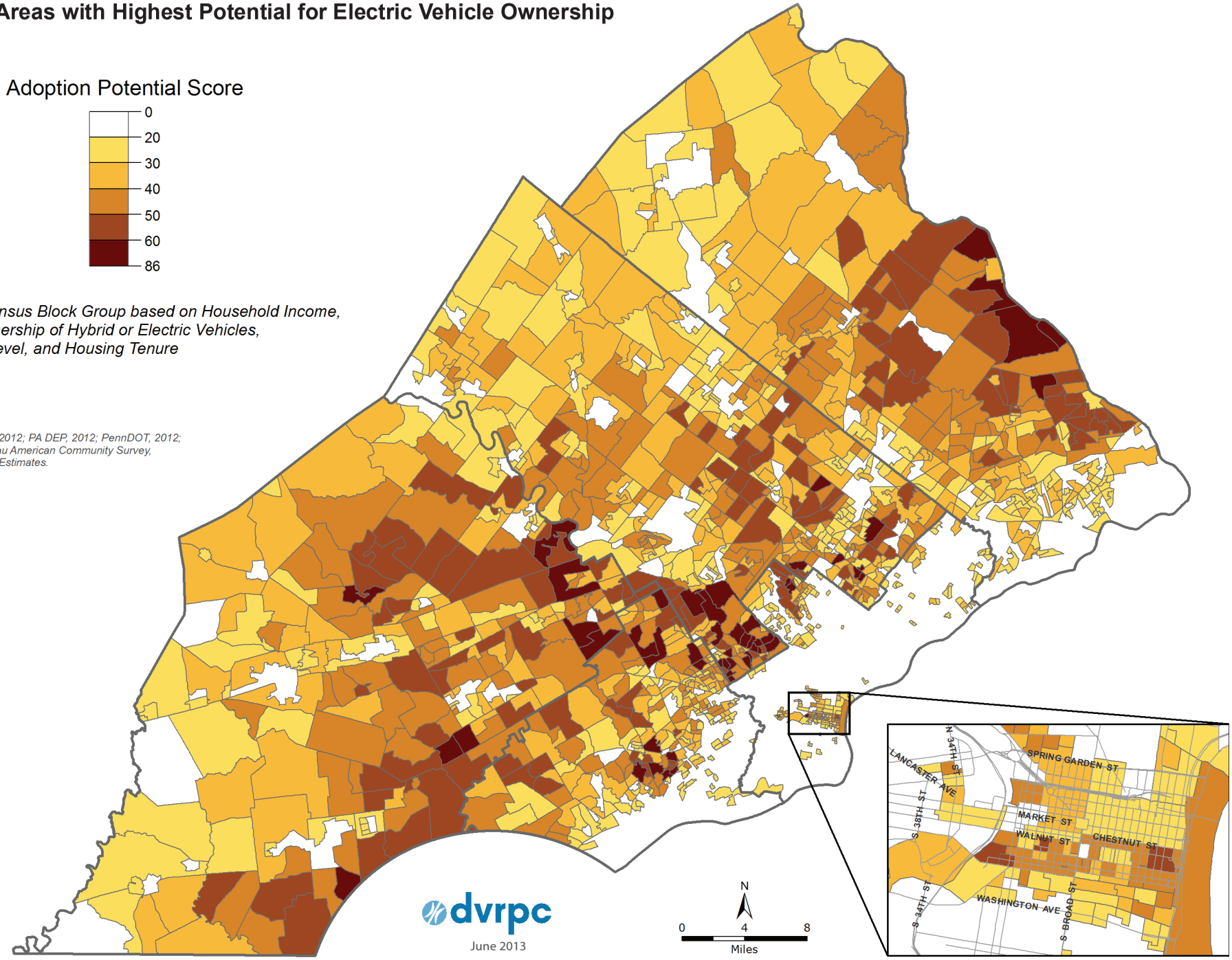
[7] L. Browning, P. Sheehy, and M. Blatt, *Technical Analysis for Alternative and Renewable Fuel and Vehicle Technology Program: Task 2—Evaluate Alternative and Renewable Fuel Infrastructure and Distribution Development for Electricity*, California Energy Commission, 2011.

[8] Ernst & Young, "Cleantech matters: moment of truth for transportation electrification," *2011 Global Ignition Sessions Report*, 2011. Accessed June 2013, http://www.ey.com/Publication/vwLUAssets/Moment_of_Truth/$FILE/Moment_of_Truth.pdf.

Figure 2. Areas with Highest Potential for Electric Vehicle Ownership



1.2.2 Workplace and private-access EVSE

There were eight private-access charging stations for fleets in the southeastern Pennsylvania area in February 2013. It is anticipated that the amount of private-access infrastructure will increase as additional fleets invest in EVs. The *Ready to Roll!* project team identified areas with the highest potential for workplace charging station deployment based on spatial data on employment, roadway and interchange volume, major destinations, and informed in part by the DVRPC household travel survey. The survey concluded 90 percent of all vehicles are parked for at least four hours (240 minutes), and that 80 percent are parked for at least six hours (360 minutes), providing enough supplemental electricity to extend the commuting distance for many drivers. Additional information about the household travel survey is provided in Volume II. The results of this analysis are displayed in Figure 3, which indicates optimal locations for future public EV charging stations (including workplace charging).[9]

Through The EV Project, ECOtality provided free charging infrastructure to workplace participants and rebates toward installation costs. This program completed a total of 125 commercial EVSE installations throughout southeastern Pennsylvania, many of which serve as workplace chargers.[10] DOE has also launched the Workplace Charging Challenge, with a goal of increasing the number of employers offering workplace charging over the next five years.[11] Though this program does not offer financial incentives, it does offer participants technical assistance, informational resources, an information-sharing forum, and national recognition as a Workplace Charging Challenge Partner.

The project team used charger-to-vehicle ratios developed by Electric Power Research Institute (EPRI) regarding the optimal use of workplace charging stations, in combination with EV deployment estimates for southeastern Pennsylvania, in order to estimate the number of charging stations required to support the predicted number of vehicles on the road. Based on this analysis, up to 2,100 workplace charging stations will be necessary to support the forecast EVs in the region in 2020.[12] It is unclear at this time what level of charging will be sought by employers. Although the current focus of the industry has been on deploying Level 2 EVSE, Level 1 charging will likely be a viable option for workplace charging. This is especially true for PHEVs because of their battery size and the length of time the vehicles are typically parked. Furthermore, Level 1 charging introduces a more manageable load for employers or parking management companies. If Level 1 charging stations are installed, the project team predicts that they will displace, rather than supplement, Level 2 charging stations. Level 1 charging at the workplace is particularly attractive due to the lower costs.

Projected Workplace Charging Location Analysis

Local governments may wish to consider emphasizing workplace charging as part of the EV readiness process. As illustrated by the "charging pyramid" developed by DOE in Figure 4, industry observers generally agree that the majority of EV drivers will charge their vehicles overnight at home, where it is convenient and when rates may be most attractive. However, workplace charging will likely be the next most important charging opportunity for EV drivers, considering the amount of time vehicles spend parked at work during the day.

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[9] For in-depth discussion of the analysis and results, see Volume II, Section 5.

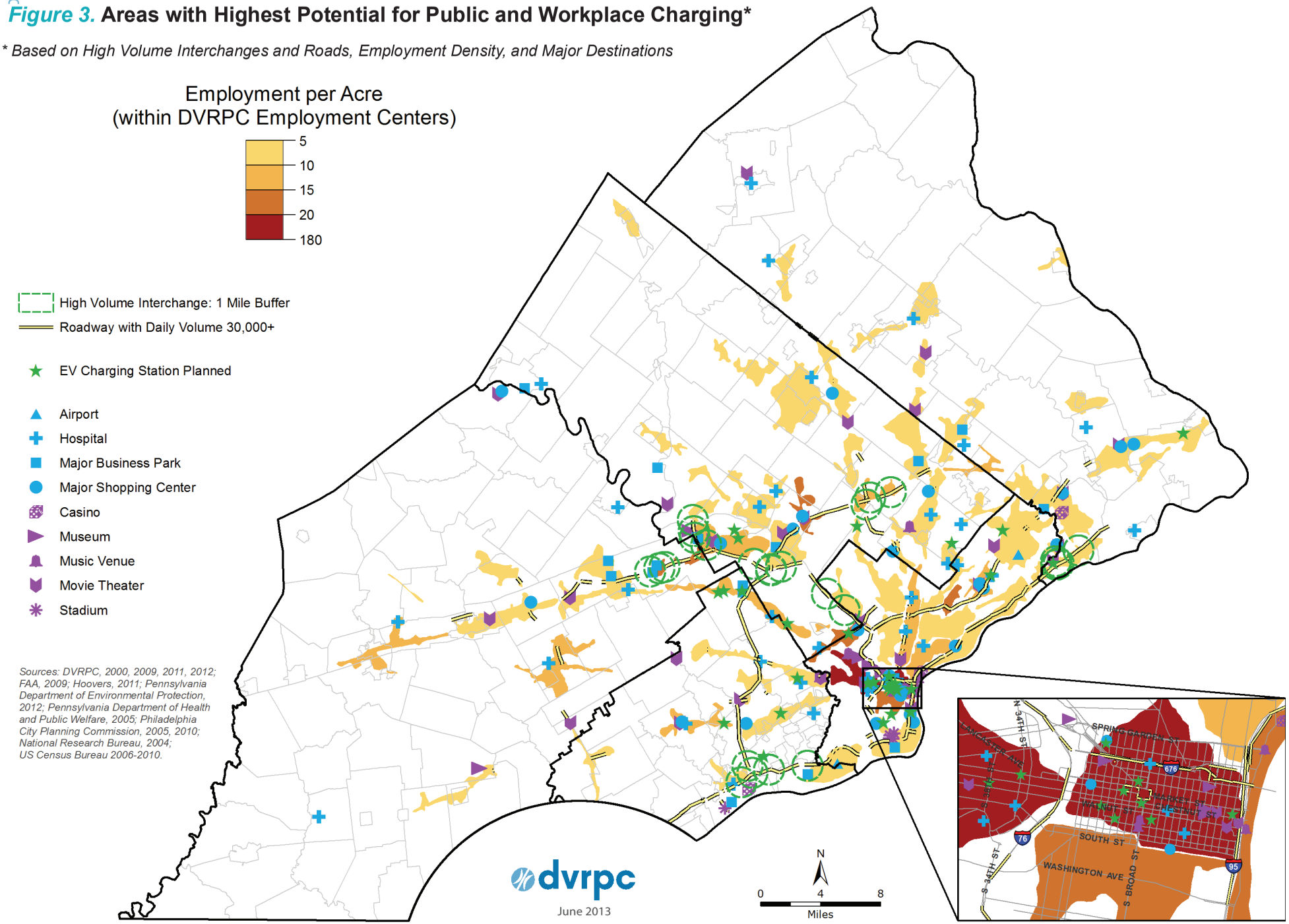
[10] Marc Sobelman, ECOtality, e-mail messages to author, November 15, 2012; April 8, 2013.

[11] See: https://www1.eere.energy.gov/vehiclesandfuels/electric_vehicles/workplace_charging.html.

[12] ICF Analysis and Dan Bowermaster, "How Much Electric Vehicle Charging Is Needed? Data and Results of Supportive Charging," Electric Power Research Institute, presented at California Plug-in Electric Vehicle Collaborative Meeting, August 15, 2012.

Figure 3. Areas with Highest Potential for Public and Workplace Charging*

** Based on High Volume Interchanges and Roads, Employment Density, and Major Destinations*



With this in mind, the *Ready to Roll!* project team focused the siting analysis on likely EV adopters, including geographical considerations based on the American Community Survey and HEV ownership patterns. This analysis provides insight with regard to where EV drivers can be expected to charge their vehicles most frequently. But it also provides a starting point for the next iteration of the siting analysis: In what areas do most EV drivers commute to work? Understanding the specific areas that are most likely to be work trip destinations for potential EV drivers can help DVRPC and its partners coordinate outreach, education, and if possible, incentives.

In addition to the locational analysis of public and workplace charging discussed above, the project team has identified the Longitudinal Employment Household Dynamics (LEHD) database as a potentially valuable resource to conduct an enhanced workplace EVSE siting analysis. The LEHD database is developed by the U.S. Census Bureau in coordination with its state partners and is largely based on administrative records including all employment subject to state unemployment insurance laws. Of particular interest, the database includes LEHD Origin-Destination Employment Statistics (LODES), which provide detailed spatial distributions of workers' employment and residential locations and the relation between the two at the census block level. LODES also provide characteristic detail on age, earnings, industry distributions, and local workforce indicators.

Figure 4. **Charging Pyramid**

Source: Argonne National Laboratory, 2013

The project team recommends future research explore the feasibility of using the LODES database to gain insight into the likely origin-destination flows of potential EV adopters using the profiles developed as part of the siting analysis in this study. Despite the potential value of these data, the project team's initial review also indicates that there are likely some data limitations. For instance:

- LODES data is a good source of home-to-work flows; however, it does not indicate modes or travel time. LODES would need to be paired with good local data regarding commuting modes to ensure, for instance, that areas with high potential for EV adoption were not also areas with high percentages of mass transit commuters. Otherwise, the analysis might over-estimate the potential for workplace charging opportunities in areas where there are actually large numbers of non-driving commuters.
- The LODES data do not include some employment categories. Namely, self-employed and sole proprietors are excluded. It would be important to supplement LODES data with local knowledge or data indicating the percentage of employed individuals in southeastern Pennsylvania that are self-employed and/or sole proprietorships.
- In some cases, the LODES data may report employees of multi-site employers at a single primary address, such as a company's headquarters. In Pennsylvania, this is less of a concern due to mandatory multiple worksite reporting requirements. However, this still happens in up to five percent of cases; as a result, some areas may be erroneously designated as having a high potential for workplace charging.

Despite the limitations, LODES data – used in combination with other data sources and tools – has the

potential to provide a geospatially explicit description of the potential for workplace charging in southeastern Pennsylvania. This type of planning tool can help local communities coordinate outreach, while also providing PECO with a near- to mid-term outlook for non-residential charging opportunities. Ultimately, the targeted deployment of EVSE at workplaces can help maximize EV miles traveled, thereby maximizing both reductions in petroleum use and GHG emissions and consumer savings.

1.2.3 Public-access EVSE

As discussed above, the *Ready to Roll!* project team identified the areas with the highest potential for public charging station deployment (see Figure 3). Areas of strong expected concentration include Center City Philadelphia, the King of Prussia and Conshohocken-Plymouth Meeting areas, and the I-95 corridor north and south of the City of Philadelphia.

As of February 2013, 81 publicly accessible charging stations are in southeastern Pennsylvania, according to the Alternative Fuel Station Locator on the DOE Alternative Fuels Data Center.[13] These charging stations have been funded by state, federal, and private entities. The project team anticipates that additional charging stations will continue to come online as a result of ongoing deployment initiatives, including:

- The Pennsylvania Department of Environmental Protection (PA DEP) provided funding for 64 Level 2 chargers and 15 DC fast chargers that will be installed by December 2013.
- PECO installed three charging stations as of February 2013 and intends to install an additional 12 stations by 2014 to support its participation in the EPRI plug-in hybrid light-duty service truck pilot project.
- ECOtality installed 125 publicly accessible charging stations through The EV Project, which concluded prior to the date of publication.

The project team developed estimates for publicly available EVSE deployment in southeastern Pennsylvania based on announced projects; projections for EV deployment noted above; research from EPRI; and research from the University of California, Davis. The project team estimates that about 1,200 EVSE will be required by 2020 to support the forecast number of EVs. As noted previously, the focus of EVSE deployment initiatives to date has been on Level 2 charging; however, based on shifts toward PHEV sales over the past 12 months, it is possible that Level 1 charging will become a more attractive option.

To complement the estimates using EPRI's estimated vehicle-to-charger ratios, the project team developed an EVSE deployment model that accounts for potential market saturation and an increase in station utilization over time.[14] Based on this EVSE deployment model, the project team estimates that between 1,250 and 5,000 EVSE will be necessary to support the forecast EVs on the road in 2020.[15,16] These estimates, however, are for all non-residential charging and do not distinguish between workplace and public charging.

The project team also estimated the level of DC fast charging that would be required to support the forecast number of AEVs on the road in 2020. The project team used estimates developed by researchers at the University of California, Davis. In that work, the researchers evaluated various California statewide EV deployment and charging scenarios to estimate how many DC fast chargers would be needed to provide sufficient coverage for most of the state's anticipated EV owners.[17]

[13] See: http://www.afdc.energy.gov/locator/stations/.

[14] At the outset of vehicle deployment, more charging stations are required than at later stages of deployment.

[15] This estimate includes commercial and workplace charging stations. The project team also developed an estimate of public non-workplace charging stations and workplace charging stations based on EPRI data from the August 15, 2012 presentation, "How Much Electric Vehicle Charging Is Needed? Data and Results of Supportive Charging." Based on this data, the project team developed an estimate of 2,219 public, non-workplace charging stations deployed in the region and 3,979 workplace stations (a total of 6,198 charging stations) by 2020. Note the proximity of this estimate to the average of the project team's low- and high-end estimates (which is 6,178 charging stations).

[16] Philip Sheehy, ICF International, e-mail message to author, November 14, 2012.

[17] M. Nicholas, G. Tal, J. Woodjack, and T. Turrentine, "Statewide Fast Charging Scenarios," presented at EVS26 in Los Angeles, CA, May 2012. Available online at: http://phev.ucdavis.edu/research/evs-26/EVS26%20-%20Nicholas.pdf.

The research focuses on expanding coverage for AEVs and minimizing the percentage of miles traveled that are "un-served" with a combination of home and public charging equipment comprised of Level 2 and DC fast charging. Initial results indicate that DC fast chargers at 200 locations will be enough to serve the majority of Californians. The number of charging stations deployed at those locations, however, is dependent on the number of vehicles deployed. At a deployment of about 10,000 vehicles, the researchers conclude that approximately 225 stations are needed at those 200 locations and that, as the number of vehicles increases, the number of stations will need to increase accordingly; however, the increase is expected to be nonlinear, as the number of charges per charging station are maximized per day.

Based on the AEV forecasts for southeastern Pennsylvania and the methodology outlined above, the project team estimates that 28 to 45 DC fast charging stations at 25 to 40 locations will serve the needs of the region through 2020.

Table 1 compares the results from the project team's deployment model to estimates derived using EPRI's approach; the table also includes estimates for DC fast charging EVSE deployment.

1.3 Integrating EVSE with the Smart Grid

PECO is executing a smart grid infrastructure upgrade, which will be completed by April 2014 and will include initiatives to gain insight into the EV–smart grid interface. In conjunction with this effort, PECO is integrating the deployment projections shown in Figure 2 and Figure 3 into its distribution system planning models to facilitate grid readiness for EV charging in the region.

1.4 Potential Costs and Funding Opportunities for EVSE Deployment

The project team estimated the potential costs for EVSE deployment for two categories: residential EVSE and nonresidential EVSE.

1.4.1 Residential EVSE costs

As discussed above, the project team estimates that about 7,100 residential Level 1 EVSE and 10,000 residential Level 2 EVSE may be installed in southeastern Pennsylvania by 2020. Residents will typically be responsible for the cost of installing these private EVSE. Overall expenditures to install this residential infrastructure are estimated to range between $9 million and $23 million by 2020. Note that this estimate does not account for any tax credits or rebates. Individual households can

Table 1. **EVSE Deployment Estimates in Southeastern Pennsylvania**

	EV Forecasts		Project Team Estimates Non-residential		EPRI Methodology		DC Fast Charging	
Year	**PHEVS**	**AEVs**	**Low**	**High**	**Workplace**	**Public**	**Low**	**High**
2015	1,760	280	200	880	260	140	0	0
2020	14,300	2,900	1,260	5,000	2,100	1,160	28	45

Source: DVRPC, 2013

take advantage of the current federal tax credit for EVSE installation if the equipment is installed before the end of 2013. The tax credit is worth up to $1,000.[18]

1.4.2 Non-residential EVSE costs

Non-residential EVSE includes equipment used for publicly accessible charging and workplace charging. As noted previously, the project team estimates that between 1,260 and 5,000 EVSE will be necessary to support EVs on the road in 2020. It is unclear at this time what levels of charging will be sought for publicly accessible EVSE and workplace EVSE deployment. The project team developed low and high cost estimates using the estimates based on EPRI's methodology because the estimates are within range of the project team's low and high EVSE estimates. The project team also assumed two different ratios for Level 1 and Level 2 EVSE deployment in the region. In one case, the project team assumed that Level 1 and Level 2 EVSE would be deployed in equal amounts (50/50), and in the other case, the project team assumed that 75 percent of workplace and public EVSE would provide Level 2 charging capabilities. The low and high cost estimates for these scenarios are shown in Table 2.[19] Note that these costs would be lower if Level 1 EVSE were to account for more than 50 percent of non-residential EVSE deployment.

The project team also estimates that 28 to 45 DC fast charging stations at 25 to 40 locations will serve the needs of the region through 2020. While individual station hosts will each be responsible for the cost of their DC fast charger installation, the project team estimates that total expenditures to fund this level of DC fast charging EVSE will range between $460,000 and $1,845,000. These costs will vary based on factors such as the hardware, permitting fees, installation costs, and trenching and concrete costs.

Employers seeking to install infrastructure at workplaces or commercial entities interested in deploying EVSE may seek funding to reduce initial capital costs associated with infrastructure. Commercial entities are eligible for the current federal tax credit for deploying EVSE, which covers 30 percent of the cost up to $30,000. The tax credit is available only for installations completed before the end of 2013. Other incentives include Pennsylvania Energy Development Authority grants, U.S. Federal Highway Administration (FHWA) Congestion Mitigation and Air Quality Improvement (CMAQ) and Surface Transportation Programs, and DOE Clean Cities.

Table 2. Estimated Costs (in millions) for Non-Residential EVSE Deployment

Year	EVSE Deployment EPRI Methodology	50 Percent Level 1 / 50 Percent Level 2		25 Percent Level 1 / 75 Percent Level 2	
		Low	High	Low	High
2015	540	$0.53	$1.48	$0.62	$ 1.72
2020	3,400	$3.31	$9.26	$3.87	$10.75

Source: DVRPC, 2013

[18] See Volume II, Section 9 for an in-depth discussion of tax credits and rebates available to individuals purchasing and installing residential EVSE.
[19] This cost estimate is based on the low/high cost estimates for MUD/workplace Level 2 and DC Fast EVSE found in Volume II, Section 6.

2 Barriers and Recommendations for EV and EVSE Deployment in Southeastern Pennsylvania

Southeastern Pennsylvania faces many of the same barriers to EV and EVSE deployment as the rest of the nation, including: a regulatory environment that may not be ready to handle the new and dynamic needs of EVs and supporting infrastructure; lack of consistent EV and EVSE signage and associated guidance; limited EVSE-equipped parking; and a need to increase public knowledge of and confidence in EVs. Nonetheless, communities in southeastern Pennsylvania are beginning to address these issues and prepare the region.

This section includes a discussion of the barriers and presents recommended solutions tailored to regional local government needs, developed based on discussions with a wide variety of stakeholders, industry best practices, and experiences from similar communities across the country.

2.1 Building and Electrical Codes

If local plans do not identify environmental sustainability as a community priority, it can be difficult to justify regulations or projects intended to promote EVs or EVSE. Communities in southeastern Pennsylvania cannot amend building and electrical codes to address EVs and EVSE because Pennsylvania generally does not permit municipalities to exceed the state-level Uniform Construction Code (UCC). Thus, communities in the region must consider alternative approaches to support EV and EVSE deployment.

2.1.1 Implement or revise existing plans

Plans can provide general support for initiatives that reduce the community's environmental impact, reduce petroleum dependence, or achieve other goals and can specifically identify EV and EVSE deployment as a community priority. Comprehensive plans, sustainability plans, and EV readiness plans each have advantages for communities interested in accelerating EV and EVSE deployment. For example, incorporating an environmental component in a comprehensive plan can be more affordable than drafting a separate plan (i.e., if a community has already begun drafting a plan, designing the environmental component adds only an incremental cost). However, if a community does not anticipate updating the comprehensive plan in the near future, a dedicated sustainability plan or EV readiness plan (which can be initiated at any time) may allow a community to outline specific implementation measures. These measures will still require the community to mobilize resources and political support for a targeted planning effort. The decision about which plan would be most appropriate will depend on the community's plan adoption timelines, available resources, and political support.

2.1.2 Encourage EVSE in new construction

Although communities in southeastern Pennsylvania may not implement stricter requirements than those in the Pennsylvania UCC, communities might promote observance of green building practices by calling attention to national incentives for EVSE deployment. For example, the U.S. Green Building Council Leadership in Energy and Environmental Design (LEED) program provides LEED points for special "green vehicle parking," which will help a building achieve certification.[20]

[20] See: http://new.usgbc.org/leed/rating-systems.

2.2 Zoning Codes

Local zoning codes that do not reference, or are inconsistent in their references to, EVs or EVSE can create confusion about what is permitted or expected by the regulations. To overcome these barriers, communities might consider the following recommendations.

2.2.1 Adopt consistent EV-related definitions

Definitions can clarify the intent and scope of new EV-related regulations and reduce confusion about how to interpret, implement, and enforce the new regulations. They may also be a first step to lay the foundation for future EV-related regulations. EV-related definitions can be adopted in conjunction with new EV and EVSE regulations. Alternatively, they can be added to local codes independently.

The City of Philadelphia has developed EV-related definitions and included them in its municipal code (The Philadelphia Code, Title 12. Traffic Code, Section 12-1131. Electric Vehicle Parking).[21] These are available for review in Appendix H. The PennDOT Vehicle Code also includes definitions related to EVs (Pennsylvania Code, Title 75. The Vehicle Code, Chapter 1. General Provisions).[22] Other municipalities should model their definitions on these existing codes to enhance regional consistency.

2.2.2 Adopt EVSE design standards

Communities could include EVSE design standards in their local zoning codes to facilitate EV and EVSE deployment. Standards may pertain to EVSE location, accessibility, equipment type, maintenance, and signage and labeling.

2.2.3 Add EVSE as a permitted use

Communities should consider amending local zoning codes to support EV and EVSE deployment by adding EVSE as a permitted use in some or all zoning districts. While communities addressing EVSE in zoning codes typically identify EVSE as a permitted use in most or all districts, they do have the option of qualifying permitted uses to best suit their needs. For example, communities may consider specifying whether EVSE are permitted as a principal use or an accessory use for each district.

The Borough of Phoenixville (Chester County) is currently drafting code language to promote EVs and EVSE. The borough's Policy Committee is focusing on zoning codes to allow for "big picture" planning.[23] For this reason, it may choose to amend the zoning code to accommodate EVs and EVSE. The City of Philadelphia amended its traffic code and recently adopted a revised zoning code after a multiple-year revision process.[24] The City may incorporate specific EVSE zoning provisions in future code amendments.

2.2.4 Require EVSE for specific land use developments

A community can go beyond simply allowing EVSE as a permitted use in the zoning code by requiring EVSE installation in specific kinds of development. For example, a community may require EVSE installation in developments of a certain square footage, including construction of new buildings, off-street parking facilities, or additions to existing buildings or parking facilities. Communities may also choose to specify the type of land uses required for EVSE, such as multi-household residential uses or commercial land uses.[25] The zoning code could set a minimum numerical or percentage-based requirement for EV parking spaces for each development type. Communities can decide whether those reserved EV parking spaces must include EVSE. In an effort to provide flexibility, communities may also determine a range of parking spaces for each kind of development that must include EVSE (e.g., two percent).

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[21] See Volume II, Appendix H.
[22] Pennsylvania Department of Transportation, "The Vehicle Code (Title 75)," accessed June 2013, http://www.dmv.state.pa.us/vehicle_code/index.shtml.
[23] Adam Supplee, KMS Design Group, LLC, personal interview, October 11, 2012.
[24] Sarah Wu (City of Philadelphia Mayor's Office of Sustainability), phone interview, October 15, 2012.
[25] City of Mountlake Terrace, "Ordinance No. 2553," accessed June 2013, http://www.mrsc.org/ords/m67o2553.pdf.

2.2.5 Require pre-wiring or installation of electrical conduit for potential future EVSE

As opposed to requiring the installation of EVSE, communities might consider developing requirements that developers prepare for potential future EVSE by sizing electrical rooms to accommodate EVSE or installing basic electrical infrastructure necessary for EVSE, such as pre-wiring, also known as stubouts, or electrical conduit.[26] Requiring pre-wiring or installation of electrical conduit for all new construction or for particular kinds of development, such as single-family homes, MUDs, and commercial or industrial development, would involve a small upfront investment that would save time and money for future retrofits. Communities that adopt such requirements might consider developing guidance materials for developers to educate them about the cost difference between pre-wiring and installation of electrical conduit in new construction to accommodate EVSE, whether or not the installation occurs immediately, and retrofitting a pre-existing structure to accommodate EVSE.

As an example, the City of Los Angeles, California, has required that all newly constructed buildings provide the necessary hardware for EVSE, and that one- and two-family dwellings and townhouses be equipped with at least one Level 2 charging outlet or panel capacity and conduit that will allow for future outlet installation. The City also has requirements for high-rise residential and non-residential buildings with common parking areas.[27]

2.2.6 Offer incentives for developers to provide EVSE

As an alternative to requiring installation of electrical conduit, pre-wiring, or installed EVSE, communities can provide incentives to developers who include electrical conduit or pre-wiring or install EVSE in new construction. Incentives, such as density bonuses, may encourage developers to include EVSE in their design plans. Density bonuses allow developers to build more square footage than normally allowed by the standard floor area ratio in exchange for installing EVSE. Communities might also count EV parking spaces toward minimum requirements or reduce minimum parking space requirements when developers include EVSE in their designs. For example, the City of Kansas City, Missouri, allows EVSE to count toward satisfying off-street parking requirements.[28] This approach could be especially appropriate in densely populated communities and for developments that have traditionally taken advantage of car-sharing programs or shared parking agreements (i.e., arrangements where parking spaces are available for different users at different times). Candidates for reduced parking requirements include job centers, downtown cores, or other mixed-use developments.[29]

2.3 Installation Processes

The installation process for EVSE can be daunting to potential EV consumers if it is difficult to identify installation steps and qualified electricians. Utilities and communities may overcome this barrier by following the recommendations below.

2.3.1 Provide a database of local licensed electricians

Access to a database of local licensed electricians trained in EVSE installation may assist potential and current EV owners interested in EVSE to locate a knowledgeable professional in their area. Communities in Pennsylvania establish individual licensing requirements for electricians, presenting an opportunity to provide license information to residents and businesses. Such a database could be established and maintained by a cooperative effort between electricians' organizations, the EV and EVSE industry, and PECO.

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[26] In some cases (e.g., under the pavement of a parking lot), developers might prefer to install the electrical conduit without the wiring – they may not know the size of wire needed until the EVSE is specified and installed several years in the future.

[27] U.S. DOE, "Plug-In Electric Vehicle Ready Building Requirements – Los Angeles, CA," *Alternative Fuels Data Center*, accessed June 2013, http://ladbs.org/LADBSWeb/LADBS_Forms/PlanCheck/2011LAAmendmentforGreenBuildingCode.pdf.

[28] City of Kansas City, Missouri, 'Chapter 88: Zoning and Development Code," accessed June 2013, http://cityclerk.kcmo.org/liveweb/Documents/DocumentText.aspx?q=9TPpZcbh%2bIXautG8IWiqrbZr3SDYecOVraOb4rusTVSZwhvKCFutuOhadUPV%2filW.

[29] Association of Bay Area Governments et al., "Ready, Set, Charge, California!," accessed June 2013, http://www.rmi.org/Content/Files/Readysetcharge.pdf.

2.3.2 Provide an EVSE installation checklist for consumers

A checklist for consumers as they start the EVSE installation process could walk residents and businesses through a process to determine what kind of EVSE would meet their needs, whether their existing electrical infrastructure is sufficient, and how to proceed with permitting, inspection, and installation. PECO provides recommended steps for consumers who are considering buying or have already purchased an EV.[30] Communities can either guide interested individuals to existing checklists, like the one provided by PECO, or develop their own checklists. The latter approach would allow a community to provide tailored checklists addressing local codes or requirements and specific questions about different kinds of developments, such as single-family homes, MUDs, or commercial buildings.

2.4 Permitting and Inspection Processes

The permitting and inspection processes for EVSE installation can be time consuming, expensive, and confusing. Though municipalities in southeastern Pennsylvania each handle the permitting process differently, uniformity and consistency in permitting requirements and administration/inspector training provide a predictable path for property owners, installers, and developers. Communities can simplify the permitting and inspection process by using a number of strategies, including those summarized below.

2.4.1 Provide a permit application checklist

A simple checklist with each item necessary to qualify for an EVSE installation permit may assist EV owners in preparing a permit application. Such a list might include an illustration of the site, electrical load calculations, EVSE specifications, and an electrical diagram of the work. The City of Philadelphia has drafted checklists for residential and commercial EVSE permits (see Volume II, Appendices E and F). Communities might also provide a checklist for local officials to follow when reviewing an application or inspecting an installation to expedite the process.

2.4.2 Provide guidance on the permitting process

Many municipalities already provide guidance materials online with a clear description of the permitting processes (e.g., construction permits and electrical permits). The guidance documents may benefit from revisions to assure they also include information on how to access the EVSE permit application and how to submit the application, fees, and the checklist of necessary information to include in the permit application described above. Guidance materials may also include best practices on permitting or recommendations for activities related to permitting, such as notifying the electric utility in advance.

The City of Philadelphia has developed a similar website to guide solar photovoltaic (PV) systems through the permitting and installation process.[31] This page includes a general description of the type of permit(s) required for solar PV installations, as well as links to the necessary permit application, a one-page guide to permitting steps and requirements for standard one- and two-family dwelling solar PV installations, and a full guide to solar PV installation, which includes solar PV basics, system design considerations, relevant codes and regulations, and information about permit application requirements. This website could serve as a model for a companion website for EV-related permitting and installation.

2.4.3 Make permits available over-the-counter or online

Over-the-counter (OTC) or online permit applications may ease the process for EV owners. OTC permits, which can be reviewed and issued while the applicant waits, are best suited for simple projects that do not require an extensive plan review. Such permits would require the permit official who reviews and issues permits to be familiar with EVSE permit requirements. Online permit applications may also be an option to reduce or eliminate trips to the permitting office and standardize and organize the application for the permitting office's review.

[30] PECO, "Your resource for everything EV," accessed June 2013, https://www.peco.com/Environment/GreenVehicles/EletricVehicles/Pages/Overview.aspx.
[31] See: https://business.phila.gov/Pages/SolarPVSystemInstallations.aspx.

2.4.4 Prepare permitting and inspection officials to evaluate EVSE permits and installations

Communities may increase the efficiency and effectiveness of permit application reviews by assuring permitting and inspection staff is prepared to evaluate EVSE permits and installations. One way to prepare staff is to provide written procedures for officials to follow when reviewing an application or installation. Alternatively, communities might encourage or require their staff to participate in training on EVSE installation for officials to learn about the technical considerations associated with EVSE projects. Not all permitting and inspection officials need to be knowledgeable about EVSE projects. In early EV deployment stages, each permitting office may only need one knowledgeable permitting and inspection official to handle all EVSE permit applications and inspections. As EVSE projects become more common, communities may consider preparing additional staff members as needed.

2.4.5 Match the permit fee to the cost of permit processing

Communities might consider calculating the cost to process an EVSE permit and assigning a permit fee based on that cost as opposed to assigning a flat fee or tying the permit fee to the cost of the project. This cost-recovery approach will establish uniformity for all EVSE permit applicants and not discourage those planning more costly EVSE installations who otherwise would face a high fee based on project cost.

2.4.6 Waive the inspection for simple EVSE installations by trained or experienced electricians

To expedite the EVSE installation and inspection process, communities might consider waiving the inspection requirement for simple EVSE installations and allowing trained electricians to self-inspect. For example, communities could allow electricians to self-inspect if they are registered as "trained in EVSE installation" in the database described in Section 2.3.1. Alternatively, electricians who install a certain number of EVSE projects that pass inspections could qualify for self-inspection.

2.4.7 Enable 24-7 inspection requests

A 24-7 inspection scheduling system may make the EVSE inspection process more convenient for applicants. Communities might consider allowing applicants to request an inspection by leaving a phone message or filling out an online request form, rather than requiring them to speak directly to a staff person during office hours.

2.5 Parking Rules

A major issue facing current and potential EV drivers is the absence or misuse of parking spaces to charge EVs. Developers may be reluctant to install EVSE and reserve EV parking spaces if it interferes with parking requirements. Moreover, when EV parking is provided, EV drivers often worry that non-EVs will park in EV parking spaces. To allay developer and EV consumer concerns regarding parking, local governments might consider the following recommendations.

2.5.1 Specify design criteria for EV parking spaces

Communities can ensure the safety and accessibility of public EV parking spaces by specifying design criteria, such as the appropriate size, location, lighting, EVSE dimensions, curb clearance, maintenance, terms-of-use notification, and signage. Communities may choose to specify the same or different criteria for off-street and on-street parking spaces.

2.5.2 Establish clear regulations and enforcement policies for EV parking spaces

Parking regulations and enforcement policies can mitigate EV consumer concern about non-EV drivers parking in EV parking spaces by establishing clear expectations for the use of the parking spaces and the consequences for any violation. Communities can include the following items in EV parking regulations: which types of vehicles can park in EV spaces; how long a vehicle can park in an EV space; and whether an EV must be charging to use an EV space. Likewise, enforcement policies can define the authority responsible for ensuring compliance and the consequences of violating the rules (e.g., fines or vehicle removal).

Parking rules work together with signage (see Section 2.6 below). Clear parking regulations and enforcement policies will legitimize any signage defining terms of use at the parking space, improving the likelihood of driver compliance. Communities should adopt a parking ordinance before installing regulatory EVSE signage to reduce the risk that people will disregard regulatory signage as unenforceable.

2.5.3 Allow reserved EV parking spaces

As an alternative to establishing minimum requirements for EV parking or requiring EVSE in new or existing developments, some communities may choose to allow reserved EV parking for residents or businesses that request it. For example, the City of Philadelphia adopted provisions in its municipal traffic code to allow residents to reserve an on-street EV parking space in front of their property (The Philadelphia Code, Title 12. Traffic Code, Section 12-1131. Electric Vehicle Parking).

2.5.4 Consider responsibilities associated with EV parking spaces

When establishing EV parking rules, communities may designate a local government agency or office responsible for enforcement, maintenance, and fee collection. If a private entity will be responsible for the EV parking spaces, specify what, if any, role the local government will have in supporting or regulating the entity's efforts.

2.6 Signage Standards

Lack of clear, consistent signage may challenge an EV driver's ability to locate EVSE and create questions about access. Signage includes markers at the charging station, in the surrounding area to direct drivers to the charging station, and on major highways. Although communities are not able to dictate or enforce signage in private lots, they may facilitate clear and consistent signage in public parking settings by considering recommendations such as the following.

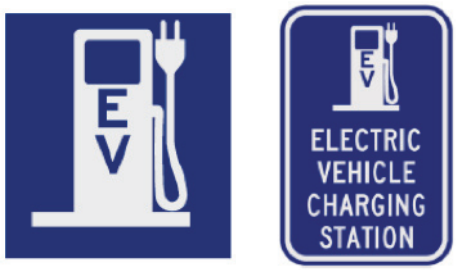
2.6.1 Collaborate with neighboring jurisdictions to develop consistent signage

Communities may coordinate with neighboring jurisdictions to share information about signage under consideration. This communication will facilitate consistency between neighboring jurisdictions to reduce confusion about EVSE availability and use requirements. At the date of publication, no EVSE signage standards existed in Pennsylvania, with the exception of general service designation signs contained in the Manual on Uniform Traffic Control Devices (MUTCD). There is therefore an opportunity for communities to collaborate to develop regionally consistent signage.

2.6.2 Use signage consistent with FHWA Manual on Uniform Traffic Control Devices

The federal MUTCD establishes a national standard for all signs on public roadways. Figure 5 displays the MUTCD experimental sign, D9-11b (Alternate), to identify parking spaces equipped with EVSE.[32, 33, 34] This sign has garnered acceptance across the United States and may become a federal standard. In an effort to foster future consistency, communities might consider using this image as the basis for any EVSE guidance and parking space signage.

Figure 5. **D9-11b (Alternate) Interim Approved Symbol[35]**



Source: Puget Sound Regional Council, 2012

[32] FHWA, "Manual on Uniform Traffic Control Devices: Pennsylvania," accessed June 2013, http://mutcd.fhwa.dot.gov/resources/state_info/pennsylvania/pa.htm.
[33] Commonwealth of Pennsylvania, "Pennsylvania Code 212.2," accessed June 2013, http://www.pacode.com/secure/data/067/chapter212/subchapAtoc.html.
[34] County of Sonoma, "Electric Vehicle Charging Station Program and Installation Guidelines," accessed June 2013, http://www.sonoma-county.org/prmd/docs/misc/ev_prog_guidelines.pdf.
[35] Source: Puget Sound Regional Council, "Electric Vehicle Infrastructure: A Guide for Local Governments in Washington State," June 2013, http://psrc.org/assets/4325/EVI_full_report.pdf.

2.6.3 Install adequate way-finding signage in the vicinity of public-access EVSE

While GPS-linked smartphone applications used by major EVSE system operators may allow drivers to navigate to the general area of a charging station, way-finding signage is essential to direct drivers to the specific EV parking space. Communities may develop task forces to ensure that consistent, adequate way-finding signage is installed throughout their jurisdictions to guide EV drivers to publicly accessible EVSE. Any such task forces must coordinate with PennDOT to approve signage on state roads located within the jurisdictions and ensure adequate signage to direct travelers to local EVSE.

2.7 Procurement Policies

Barriers to EV deployment include upfront cost and low levels of familiarity and comfort with the technology. To help overcome these barriers and gain traction for EVs, leaders in the region show commitment to EV and EVSE deployment by deploying the technologies in local fleets.

2.7.1 Include EVs and EVSE on local purchasing lists

Government purchases have the potential to stimulate the market for a given type of vehicle or fuel. Fleet vehicles can increase vehicle exposure, lower vehicle costs through economies of scale, and provide proof of demand to vehicle dealers who are uncertain about offering EVs. As a first step toward fleet EV deployment, government agencies can add EV and EVSE models to their purchasing lists. This increases awareness of the options available to purchasing departments.

2.7.2 Adopt procurement policies that prioritize or align with EV advantages

To support fleet EV deployment, local governments can prioritize EVs in their purchasing policies. Many communities have already adopted policies to prioritize procurement of low-emission vehicles (LEVs) or alternative fuel vehicles (AFVs), such as setting a target for the percentage of its fleet that is comprised of LEVs or AFVs. Others have chosen to allow or require consideration of environmental criteria in the procurement process or determined that any vehicle replacements must be LEVs or AFVs if appropriate models are available. Communities may consider amending policies that have been used to support LEVs or AFVs in the past and tailoring them to promote EVs. Alternatively, communities might consider creating new policies that include EV procurement guidelines, and incorporate operations and maintenance costs together with initial vehicle costs in procurement decisions.

In addition, local governments can ensure that their vehicle cost analyses properly account for the operation and maintenance costs of candidate vehicles. Not only will this improve the prospects for EVs, but it will help improve the fuel efficiency of fleets in general.

2.8 Marketing, Outreach, Training, and Education Plan for Southeastern Pennsylvania

2.8.1 Provide general information about EVs and EVSE

Existing initiatives in southeastern Pennsylvania have shown that providing regional stakeholders with EV and EVSE information has increased interest in the technology. The Borough of Phoenixville invited an EVSE expert to speak with the public and government officials about the benefits of EVs and EVSE. After learning more about benefits, trends, and concerns related to EVSE, the public and the borough Policy Committee drafted a local zoning amendment to support EV and EVSE deployment.[36] GPCC has also recommended providing a comprehensive presentation to inform all stakeholders, from utilities to vendors to consumers.

2.8.2 Conduct audience-specific outreach and training

Conducting targeted outreach and training for specific stakeholder groups can increase public awareness. Key EV stakeholder groups include fleet managers, vehicle dealerships, electricians and inspectors, local government staff, utilities, first responders, property managers, and parking garage operators. For example, for electricians, communities could develop an EVSE installation training

[36] Adam Supplee, KMS Design Group, LLC, personal interview, October 11, 2012.

course or team with neighboring communities to offer courses. Alternatively, communities may publicize existing EVSE installation courses in the region, such as the certification course offered by the Electrical Association of Philadelphia or trainings offered by local chapters of the International Brotherhood of Electrical Workers (IBEW).[37] They might also publicize courses offered nationwide, such as EVSE manufacturer training programs or the Electric Vehicle Infrastructure Training Program (EVITP), which offers training at community college and electrical training centers.[38] EVSE installation trainings should be tailored to local building requirements, counted toward any applicable licensing requirements, or associated with an independent certification.

2.8.3 Partner with local organizations

Stakeholder groups may partner with local organizations to expand the reach and effectiveness of outreach, education, and training efforts. GPCC recommends reaching out to local stakeholder groups (e.g., electrical unions and county governments) to provide a brief presentation by an EV expert on a regular meeting agenda. The expert could provide an introductory presentation and direct interested individuals to a training program for further information. Alternatively, partners could host a training workshop. Such a partnership increases exposure of the EV and EVSE information to group members and reduces the costs associated with training.

2.8.4 Establish a speakers bureau

To formalize outreach to local and regional organizations, GPCC could establish a speakers bureau—essentially a database of individuals with expertise in EV or EVSE—and arrange for speakers to come talk with local businesses, non-profit organizations, or other stakeholder groups. The speakers' bureau could reach out to local and regional organizations to plan educational programs, and vice versa. The bureau could handle logistics and fee negotiations, as necessary, and increase access to experts.

2.8.5 Engage vehicle dealerships

Dealerships can potentially serve as a go-to source of information for EV consumers. Most EV manufacturers develop relationships with one or more preferred EVSE suppliers, who often have informational materials addressing the installation and operation of EVSE, along with applicable incentives, and information about special electric utility rates. In addition to serving as an information resource, dealerships can conduct direct marketing to vehicle consumers to promote EV deployment (by holding "ride and drive" events, for example). Dealerships may bring resources for marketing that could be coordinated with those of other regional stakeholders to increase the scope and effectiveness of EV marketing efforts.

2.8.6 Use a variety of media

Communities can use a variety of media, including online resources, videos, and print materials, to educate the general public as well as fleet managers and other potential EV consumers. A website can provide an engaging source of general information about EVs and EVSE, as well as information tailored to specific audiences. The inclusion of videos on a website can provide an additional entertaining and informative supplement to speaker presentations and reading materials. Print materials (e.g., one-page handouts, brochures, and handbooks) can serve as a useful take-away and can be made available at local government offices, vehicle dealerships, and education or outreach events that discuss EVs and EVSE.

2.8.7 Include EV readiness in community marketing materials

Communities that show leadership through EV deployment initiatives can market themselves as forward-looking communities. Communities may include information about public-access EVSE, EV fleets, and related promotion efforts. Tourists may be

[37] The Electrical Association of Philadelphia, "Spring 2012 Continuing Education Courses," accessed June 2013, http://www.eap.org/documents/finalpacket2012pdf.pdf.
[38] U.S. DOE, "Electric Vehicle Infrastructure Training Program," accessed June 2013, http://www1.eere.energy.gov/cleancities/evitp.html.

drawn to destinations that support and incorporate "green" initiatives. Furthermore, such marketing efforts may generate interest among residents in joining their communities' EV and EVSE deployment efforts and investing in the technology themselves.

2.9 Enhance Demand for EVs and EVSE through Incentives

Despite the federal EV and EVSE tax credits available today, high upfront vehicle costs and low consumer knowledge about or confidence in EVs continue to be cited as the primary reasons for low consumer demand for EVs. As discussed in Volume II, while there may be other contributing barriers (e.g., consumer concerns about vehicle range, EVSE accessibility, and vehicle charge time), these two barriers are expected to remain the main near-term challenges to widespread EV adoption. The upfront cost barrier in particular is compounded by the additional cost of installing EVSE at home. Communities may address the cost barrier by considering the recommendations below.

2.9.1 Provide non-monetary incentives for EV drivers

Local governments across the United States have developed incentive programs for EVs to encourage deployment. While some communities have facilitated EV and EVSE deployment by offering grants or rebates for EV purchase or EVSE installation, this may not be a viable option for southeastern Pennsylvania due to lack of available funds on the municipal level. However, local governments can offer convenience incentives, such as priority parking, which reserves some convenient parking spaces for EVs. Communities may also consider exemption incentives, such as exemptions from parking fees or time-of-day/day-of-week roadway restrictions.

2.9.2 Provide incentives for EV taxicabs and car rental programs

Incentives to encourage taxicab and car rental companies to purchase EVs may facilitate EV and EVSE deployment among these fleets. Because taxicabs and car rental fleet vehicles cover many miles within a metropolitan area, EVs may be wise investments for these fleets, both environmentally and financially. Non-monetary incentives may help these fleets overcome the initial cost associated with EVs and EVSE. Taxicab-specific incentives that have been implemented in some communities include head-of-the-line privileges, which allow EV taxicabs to advance to the beginning of the waiting line in the staging area, and extensions on vehicle operational life limits. Permitting agencies might also consider reducing permitting costs for EV taxicabs and car rental fleet vehicles.

2.9.3 Support EVSE deployment by property managers and homeowners associations

Many residents in southeastern Pennsylvania live in MUDs with shared parking facilities, which pose unique challenges for EVSE deployment, including dividing installation and electricity costs and reserving communal parking spaces. Communities might consider sharing best practices and identifying new solutions for MUD EVSE deployment that can be implemented at the local government level (e.g., permitting issues for EVSE installations specifically in MUD settings and identifying a mediator to help residents and property managers discuss options for EVSE installation in their particular developments).

2.9.4 Establish public-private partnerships to deploy EVs and EVSE

Public-private partnerships (PPPs) can leverage public and private resources to promote EV procurement, EVSE installation, and related services, such as EV carsharing. PPPs send a message that a community is committed to EV deployment and will partner with local entities to achieve EV readiness.

2.10 Utility and Other Service Provider Policies and Plans to Accommodate EVs

The primary utility concern regarding EV deployment is the adequacy of distribution infrastructure to meet the needs of additional demand due to EV charging. As mentioned above, PECO is already implementing a large-scale infrastructure upgrade in southeastern Pennsylvania, which includes the implementation of smart grid and other technologies that will help them address this barrier. Municipal utilities and communities might also consider the following additional recommendations as further steps to avoid this concern.

2.10.1 Map potential EVSE demand to identify areas in need of infrastructure upgrades

Estimating potential EVSE demand by location will enable utilities and communities to identify areas where EV charging might require additional or enhanced infrastructure. Even if this mapping process does not lead directly to installation or upgrades, it can help PECO and the region's municipal utilities to anticipate potential localized grid impacts.

Through its DOE Smart Grid Investment Grant, PECO sponsored a study by DVRPC to forecast future EV adoption and EVSE charging impacts (including home, workplace, and destination charging). This project developed that work further to create forecast maps under anticipated consumer adoption scenarios. Based on this analysis, PECO determined that its distribution system in southeast Pennsylvania has adequate capacity to meet all EV- and EVSE-driven demand requirements through at least 2020.

2.10.2 Consider alternative rate structures

Some utilities use dynamic or time-of-use (TOU) pricing to encourage customers to shift electricity use patterns. For example, a utility may charge a higher rate during hours of peak electricity demand (e.g., evening hours) and charge a lower rate during off-peak hours (e.g., overnight) to encourage electricity use during off-peak hours. By identifying goals that a dynamic pricing strategy should achieve and implementing a pilot strategy, utilities may be able to evaluate whether such rates achieve the desired goals in current market conditions. They may then propose a revised tariff structure as necessary.

As a regulated utility, PECO must have all rates approved by the Pennsylvania Public Utility Commission (PA PUC). As an example, in 2011, PA PUC ordered PECO to phase out its discounted heating rates and its off-peak heating rate for water heaters by the end of 2012. In September 2012, PA PUC approved PECO's dynamic pricing plan as part of the new Advanced Metering Infrastructure (AMI) program. PECO plans to make the Dynamic Pricing Plan available to a limited number of residential customers with new AMI meters installed at their homes. The dynamic pricing may be useful for EV drivers looking to save money by charging their vehicles during periods with less expensive electricity. A third-party Electric Generation Supplier (EGS) will provide the electricity and will offer a reduced TOU rate on PECO's behalf. PECO chose to work with a third-party EGS so that the plan could eventually lead to competitive off-peak rate offerings from the EGS community that will encourage off-peak EV charging.

Separately, PECO has pursued a number of channels to increase its understanding of customer charging patterns in southeastern Pennsylvania. PECO has obtained voluntary agreements with entities throughout the service territory that have installed EVSEs to obtain access to their usage data to obtain a more granular understanding of EVSE charging patterns. Data-sharing agreements are currently in place covering more than 25 charging stations. PECO also uses its EV incentive program to obtain agreements from individuals who purchase EVs or install EVSE equipment to monitor interval usage data for the purpose of understanding customer charging patterns.

2.10.3 Provide a mechanism for EVSE installation notification

Providing a mechanism for consumers to notify a utility about EVSE installations can help utilities anticipate any grid impacts associated with EV charging. PECO provides a $50 rebate to residential and business customers who purchase an EV and register their vehicles on the utility website. PECO also provides an incentive of $1,000 to government, institutional, and nonprofit customers to support EVSE installation when they register an EV and its associated EVSE.[39, 40] This rebate program provides PECO with information about the likely distribution of EV charging activity to allow PECO to understand customer usage patterns and plan for localized increases in electricity demand. PECO might consider extending

[39] This incentive was temporarily increased to $2,000 for the last quarter of 2012.

[40] PECO Energy, "Your resource for everything EV," accessed June 2013, https://www.peco.com/Environment/GreenVehicles/EletricVehicles/Pages/RegisterYourVehicle.aspx.

existing rebate programs to customers installing EVSE for use by employees, patrons, and others. This may encourage entities such as businesses and educational institutions to notify PECO of EVSE installations.

Although local communities may not be able to directly provide information about EV purchases and EVSE installations to utilities, they can encourage EV consumers to notify the local utility or require utility notification as part of the permitting process. For example, the City of Philadelphia is considering including utility notification in a guidance document for EVSE permitting.[41] On the state level, Maryland has granted its Motor Vehicle Administration permission to provide the address of a registered EV owner and information about the vehicle to utilities for their use.[42]

2.10.4 Install and use smart grid infrastructure

Smart grid technologies can benefit both EV owners and electricity suppliers. Smart grid technology may allow customers to time EVs charging to take advantage of the lowest rates and enable the distributor (in the case of southeastern Pennsylvania, PECO) to anticipate and prevent grid impacts associated with EV deployment.

Through the installation of its AMI network, PECO is expanding its ability to analyze and understand interval usage patterns of customers who agree to register their vehicles with PECO. Advanced technology investments also support EV investments by providing more reliable grid infrastructure and outage response capabilities.

Moreover, as EV drivers are dependent on the electric grid for their transportation needs, the ability to "ping" PECO's automated meters (using automated communications capabilities to determine whether or not a customer has power) accelerated overall system outage restoration times by two to three days during Hurricane Sandy.[43] For those areas of the PECO service territory that had AMI meters installed (approximately 12.5 percent of PECO customers), PECO was able to "ping" more than 98 percent of meters.

2.10.5 Seek opportunities to develop vehicle-to-grid technology

Vehicle-to-grid (V2G) technology refers to vehicle capabilities that provide services to the electric grid. V2G technology could help PECO and the region's other electric utilities minimize grid impacts associated with EV charging by slowing charging during periods of high demand (unidirectional V2G) or by storing electricity in vehicles and supplying it back to the grid during periods of high demand (bidirectional V2G) or to provide power regulation services.

V2G technology is under development, with EV manufacturers, utilities, and academic institutions often partnering to evaluate vehicle storage and communication capabilities. For example, Pacific Gas & Electric (PG&E) is collaborating with Tesla to develop and demonstrate an EV with unidirectional V2G capability that could provide ancillary services for the grid and identify opportunities to collaborate with manufacturers or researchers to develop V2G technologies that could support the regional electric grid.

2.11 Highway Network

2.11.1 Adequately Fund Transportation Needs

Pennsylvania's roads and bridges are supported primarily by the state and federal motor fuel tax on gasoline. While EVs bring many advantages, AEVs do not pay this tax, and PHEVs do not pay this tax for the electric portion of their miles. Although only a very small portion of all miles driven are electric miles, equity dictates that a way must be found for EVs to contribute to paying for the roads and bridges they use. This is particularly urgent today, as Pennsylvania faces a large shortfall between transportation funding needs and the revenue it receives to fund those needs.

From 2014 to 2040, the funding needed for the transportation network (including transit) in the five counties of southeastern Pennsylvania is estimated as

[41] Sarah Wu (City of Philadelphia Mayor's Office of Sustainability), phone interview, October 15, 2012.
[42] U.S. DOE, "Plug-in Electric Vehicle (PEV) Information Disclosure," Alternative Fuels Data Center, accessed June 2013, http://www.afdc.energy.gov/laws/state_summary/MD.
[43] Tom Bonner, e-mail message to author, January 29, 2013.

$91.7 billion. $74.7 billion of that amount is needed for system preservation—the repair and rehabilitation of the existing roadway and transit system. However, the revenue available from traditional federal, state, and local revenue sources to meet these needs totals only $33.2 billion. [1]

Approximately two-thirds of the region's transportation funding comes from federal sources, principally the Highway Trust Fund (HTF), which is primarily funded through gas tax receipts. The federal gas tax of 18.4 cents per gallon has not been increased since 1993. Meanwhile, the Highway Trust Fund has required $53 billion in general fund infusions since 2008 to avoid insolvency. More fuel efficient vehicles, and now the introduction of EVs, are a contributing factor to this shortfall, along with poor economic conditions, rising fuel prices, and the erosion of the gas tax's purchasing power over time.

Although current gas tax revenues are not adequate to meet all our transportation needs, maintaining our transportation network depends on this money. Some commenters suggest that EV drivers should pay for their use of the road network in some other way. Others note that EV owners already receive significant subsidies, including the $7,500 federal tax credit and the $3,000 state payment that a Volt, LEAF, or Tesla owner can receive, as well as government-funded charging infrastructure. To some, gas tax relief is simply an extension of the incentives to put these clean vehicles on the road. To others, it is seen as a subsidy for EV owners.

Others note that our current system of paying for transportation infrastructure is broken, and needs a wholesale overhaul. While most agree that EV owners should pay an equitable amount for their use of the road system, it is also clear that the issues surrounding the need for better funding for the transportation system go well beyond the relatively small number of EV drivers not paying the gas tax. Among the many options under discussion or in place to replace or supplement gas tax revenues for transportation system funding are the following:

- Tolling of roads currently not tolled;
- Increase in toll charges on roads already tolled;
- A fee based on annual miles traveled
- Money from government general funds, funded by various taxes and fees not related to road usage;
- Variable pricing for road usage, depending on level of road congestion;
- Increases in transit fares; and,
- Vehicle registration fees based on vehicle characteristics such as weight, fuel type, and miles traveled.

The issue of transportation funding goes well beyond the question of how to assure the introduction of EVs does not harm available revenues. However, policies to assure EVs pay their fair share need to be put in place.

[1] DVRPC, Connections 2040 (Unpublished Administrative Version), July 17, 2013, pp. 83-85.

3 DVRPC Stakeholders and Partnerships

DVRPC served as the primary project manager for *Ready to Roll!,* managed the development of the plan, and will disseminate it throughout the region upon project completion. Throughout the project, DVRPC guided research and modeling efforts and developed quarterly reports for DOE, in addition to hosting briefings and technical presentations. For example, DVRPC hosted a "Garage-Free" Summit in February 2012 and has developed a web-based EV clearinghouse to provide information to the general public in conjunction with the release of the report.

DVRPC leveraged its existing network of long-standing regional partnerships and its role as a locus for convening policy makers in southeastern Pennsylvania to recruit stakeholder groups for the project's Advisory Group. DVRPC also established new partnerships with a variety of stakeholders throughout the southeastern Pennsylvania region. These stakeholders included state and local governments and agencies, utility and regulatory authorities, departments of public works and transportation, property owners and operators, EV manufacturers and vendors, fleet managers, and Clean Cities coalitions. This section provides an overview of the project stakeholders, as well as their roles, responsibilities, and contributions as they relate to the development of *Ready to Roll!.*

3.1 State Government

Several Pennsylvania state agencies, including PA DEP, PennDOT, and PA PUC, have taken a leadership role in the development of EV policies and deployment initiatives in the project region. They also provided insight during the development of *Ready to Roll!*. Ongoing agency efforts include:

- Alternative Fuels Incentive Grant (AFIG) Program: PA DEP has for many years provided grants to support alternative fuel vehicles and infrastructure through its AFIG program. In both 2010 and 2011, this program supported EV infrastructure. For example, in September 2010, PA DEP issued a solicitation to fund EV infrastructure under its *Electric Vehicle Infrastructure Grants*, which awarded over $1 million for EVSE installation throughout the Commonwealth.
- Pennsylvania EV Task Force: GPCC developed a task force in partnership with PA DEP and Pittsburgh Region Clean Cities to evaluate barriers to EV deployment and develop strategies to establish, facilitate, and implement EVs and EVSE throughout Pennsylvania. The task force engages public utilities, metropolitan planning organizations, electrical unions, and PennDOT on issues related to EVs and EVSE. PA DEP is also working with the Pennsylvania Turnpike Commission through this task force to install DC fast charge stations at rest stops along the Pennsylvania Turnpike and has established relationships with EV original equipment manufacturers (OEMs) to encourage the distribution of EVs in Pennsylvania. Task force strategies have included: establishing EV corridors, supporting early adopters, and assuring understanding by policymakers of EV and EVSE technology. The Pennsylvania EV Task Force played a key role in the development of *Ready to Roll!* and will also play a key role in disseminating the plan's recommendations by providing an interface between EV activities in southeastern Pennsylvania and the rest of the Commonwealth.

3.2 Local Governments

As the Metropolitan Planning Organization covering southeastern Pennsylvania, DVRPC has several decades of experience supporting local government planning efforts by providing technical training, developing detailed implementation tools, supporting local planning efforts, and facilitating cooperation between the region's counties and municipalities. For example, DVRPC established the Alternative Energy Ordinance Working Group to bring together leadership from counties and municipalities in the Greater Philadelphia region to support the development of model ordinance "frameworks" for siting small-scale alternative energy systems, including solar PV, small wind (less than 100 kilowatts), and geothermal. The relationships developed as part of these and other efforts were critically important during the development of *Ready to Roll!*.

The Philadelphia Mayor's Office of Sustainability (MOS), which provides data to DVRPC and coordinates with decision-makers in other city agencies, has spearheaded several activities related to EVs and played a prominent role in the development of *Ready to Roll!*. MOS efforts related to EV deployment include:

- Installing 18 EVSE to serve the PhillyCarShare fleet and two public-access EVSE through a $140,000 grant from PA DEP;
- Collaborating with the City's Department of Licenses and Inspections and PECO to examine the current permitting structure for EVSE installation and identify opportunities for streamlining.
- Coordinating with the Philadelphia City Council to advocate for the enactment of a bill to allow for the designation of on-street parking spaces where only EVs may be parked for the purpose of charging. In conjunction with the enactment of this bill, the Philadelphia City Council also passed a resolution requesting that the Department of Fleet Management explore opportunities to add EVs to the City's fleet; and
- Participating in the Northeast Regional Electric Vehicle Partnership, a project funded by the Urban Sustainability Directors Network to foster an area-based approach to EV planning with New York City and Boston. The lessons learned from this partnership have informed research and policy implementation recommendations included in *Ready to Roll!*.

DVRPC also partnered with the Philadelphia Mayor's Office of Transportation and Utilities (MOTU) to develop *Ready to Roll!*. City departments reporting to MOTU include: the Streets Department, the Philadelphia Water Department, and the Philadelphia International Airport. MOTU coordinates with a number of public works and transportation authorities with operations in the project area, including the Philadelphia Parking Authority (PPA); Philadelphia Gas Works (the local gas utility); Southeastern Pennsylvania Transportation Authority (SEPTA) (the regional transit authority); and the Philadelphia Regional Port Authority.

3.3 Generators and Distributors of Electricity and Utility Regulatory Authorities

3.3.1 Distributors

PECO Energy, a subsidiary of Exelon Corporation, is the electric distribution company serving southeastern Pennsylvania (the City of Philadelphia and Bucks, Chester, Delaware, and Montgomery counties).[44] PECO manages 500 power substations and 29,000 miles of distribution and transmission lines. The utility serves approximately 1.6 million customers, about 90 percent of whom are residential. PECO is a project partner and key stakeholder in the region supporting the deployment of EVs and EVSE. The utility has launched a comprehensive corporate initiative to ensure that its business processes and regulatory policies and programs support customer adoption of EVs in southeastern Pennsylvania.

PECO is in the process of executing a $200 million DOE Smart Grid Investment Grant to deploy an automated metering and grid infrastructure upgrade (or smart grid) program that will be completed by April 2014. Through

[44] PECO serves all of Philadelphia and Delaware counties, and the majority of Bucks, Chester and Montgomery counties. Small areas of these counties farthest from the City of Philadelphia are served by other distribution companies. PECO also serves a small portion of York County located outside of the Philadelphia metropolitan area.

these upgrades, PECO will establish the backbone systems required to integrate EVs into the smart grid. Grant activities include:

- Deploying 600,000 AMI meters with bidirectional communications capabilities and interval recording capabilities. PECO has filed with PA PUC to deploy AMI meters to the remainder of its customers (approximately 1.6 million total) by the end of 2015;
- Testing the smart grid capabilities to effectively communicate with EV equipment to continually refine any future demand response programs through its AMI test center;
- Offering a range of incentives to customers in the PECO service territory to encourage registration of EVs in the service territory and installation of advanced EVSE capable of reporting interval charging data. Additionally, PECO has coordinated with The EV Project to offer enhanced incentives to government and non-profit entities to encourage the installation of 20 EVSE throughout the service territory;
- Working with DVRPC to analyze potential high-impact EV demand corridors and evaluate the impact of implied electricity use on these areas' electricity generation, transmission, and distribution infrastructure, particularly with respect to the challenges and opportunities of integrating EVs into its smart grid planning program;
- Leasing two EVs to test vehicle performance, battery charging requirements, and utility usage applications; and
- Installing EVSE at the AMI technology testing centers in Berwyn, Conshohocken, and the PECO Main Office Building in Center City Philadelphia to test communications and information technology infrastructure solutions to leverage the smart grid.

PECO received approval in April 2011 by PA PUC to implement a dynamic pricing and customer testing program in conjunction with the AMI program. This program may eventually lead to a tariff structure that will encourage off-peak EV charging, and it can serve as a model for other electric generators that serve customers in the project region.

PECO's executive team also engages directly with local government leaders on a broad array of issues and has directed the utility's alternative vehicle strategy team to engage with these leaders to identify opportunities to support EV deployment in the region. At the executive team's request, PECO formed a multidisciplinary team in 2009 to look specifically at the potential system impacts and issues that could arise from adoption of EVs in its territory. The team includes representatives of the company's Operations, Fleet, Rates and Regulatory Affairs, Economic Development, Marketing, Communications, and Governmental and External Affairs departments. The team provides quarterly briefings to PECO's chief executive officer and executive leadership teams, including updates on consumer EV adoption, usage patterns, PECO pilot programs, external partnership activities, and presentations by outside experts.

3.3.2 Generators

Pennsylvania's electricity market is one of the most mature deregulated retail electricity markets in the United States. Approximately 50 percent of electric load in the Commonwealth is served by competitive retail electric suppliers who contract directly with retail customers. The remaining customers who have not chosen a competitive retail electric supplier receive their service (referred to as default service) through PECO with power purchased from wholesale suppliers through competitive procurements.[45]

3.4 Property Owners and Operators

Owners and operators of property, including privately owned parking lots or structures and commercial developments with public access lots, are essential to the deployment of a sufficient level of public charging infrastructure in the region. DVRPC engaged with a variety of property owners in the region to develop *Ready to Roll!*, including the following:

[45] Tom Bonner, e-mail communication, January 29, 2013.

PPA: PPA is an independent authority that operates parking garages and surface lots throughout Philadelphia. PPA works directly with the City of Philadelphia's Streets Department and MOS to issue parking permits for EVs. Their parking facilities are potential sites for public EVSE.

MOS and PhillyCarShare:[46] both of these entities are working with the owners of private parking lots in Philadelphia to install EV charging stations. One such owner is Parkway Corporation, a family-owned business that is headquartered in Philadelphia and owns 51 locations with nearly 10,000 parking spaces. MOS and PhillyCarShare are also coordinating with local institutions, such as Drexel University, Temple University, and the University of Pennsylvania, to deploy EVSE on their campuses.

GPCC and ECOtality: both entities have identified EVSE deployment locations throughout the City. GPCC helped Parkway Corporation deploy five EVSE in fall 2011. GPCC has also been in involved in discussions with PPA to install charging facilities throughout Philadelphia. ECOtality installed nearly 450 EVSE (310 residential and 125 commercial) in the region through The EV Project.

3.5 Electric Vehicle Manufacturers or Vendors

Over the course of this project, the DVRPC team has contacted every major EV OEM to obtain information about their vehicles and trends in the Philadelphia region. The City of Philadelphia worked closely with General Motors in Philadelphia's PA DEP grant-funded project to install EVSE to support the use of Chevrolet Volts in the PhillyCarShare fleet.

As mentioned above, ECOtality has also played a central role in deploying EVSE throughout southeastern Pennsylvania and contributing best practices recommendations for *Ready to Roll!*. U-GO Stations, which worked with GPCC to install seven EVSE awarded through a PA PUC grant, has contributed to EVSE deployment in the region and shared experience with DVRPC throughout the development of *Ready to Roll!*. GPCC has also engaged IBEW Local 98, the primary electrical workers union in Philadelphia. IBEW has fully supported the EV initiative and will have an EVSE unit installed at its headquarters.

3.6 Fleets

A number of local and regional entities, including two project partners, are introducing or planning to introduce EVs into their fleets. These fleets have provided valuable feedback, which has informed recommendations included in *Ready to Roll!*. Examples include the following:

PhillyCarShare: This local carshare organization committed to adding EVs and other AFVs to its fleet of over 200 vehicles, beginning with 20 Chevrolet Volts in 2012.

Philadelphia City Council: By resolution, the City Council Committee on Environment is working with the City's Office of Fleet Management to investigate the feasibility of integrating EVs into the City of Philadelphia fleet by 2015.

PECO: As discussed above, PECO is executing two fleet-based EV pilot programs. The primary program, in which PECO serves as a partner with the South Coast Air Quality Management District in California and the Electric Power Research Institute (EPRI), includes 20 plug-in hybrid electric utility service trucks in PECO's distribution service operations. The utility has also leased two Chevrolet Volts that are used by its Environmental Services and Corporate Relations organizations to raise visibility and awareness. Additionally, PECO has installed three AMI-compatible charging stations, one of which is located at the company's AMI test facility, to assist in the development of strategies for EV smart grid infrastructure and technology.

[46] Just prior to the publication of this document PhillyCarShare changed its name to Enterprise CarShare. PhillyCarShare is used as it may be more familiar to readers.

GPCC has also been working with Philadelphia's largest fleets, including ARAMARK and Comcast, to facilitate the introduction of EVs in the region. Other fleets that have expressed support for EV introduction to the region include, but are not limited to, PHL Taxi, which operates over 400 taxicabs in the Delaware Valley region, the University of Pennsylvania, Temple University, and West Chester University.

3.7 Clean Cities Coalitions

GPCC has played an integral role in developing and implementing *Ready to Roll!* by supporting project partners, recruiting additional partners and stakeholders, investigating site locations for optimal usage and placement of EVSE, performing outreach to fleet operators and local governments in the project area, assisting in data collection, and activating the network of Clean Cities stakeholders, as needed.

GPCC coordinates and communicates with Pittsburgh Region Clean Cities on an ongoing basis. The coalitions share information and collaborate to deploy infrastructure through the Pennsylvania Turnpike's program for installing DC fast charge stations at rest stops across the Commonwealth to create Pennsylvania's first EV corridor. GPCC has also worked with New Jersey Clean Cities and discussed connecting the Philadelphia region to the Atlantic City Expressway and southern New Jersey using DC fast chargers. In addition, GPCC has been an invaluable resource to the Pennsylvania EV Task Force, particularly in its outreach to municipalities via existing relationships and its membership in the Pennsylvania League of Cities and Municipalities. GPCC organized a 2012 workshop devoted to EVs and EVSE, which garnered support from many municipalities in southeast Pennsylvania.

3.8 DVRPC EV Advisory Group

The project team would like to thank the following individuals for their participation in the DVRPC EV Advisory Group.

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Glossary of Terms, Abbreviations, and Acronyms

A: Amperes (also known as amps). The International System of Units base unit of electric current.

AC: Alternating Current. Electric current that changes direction with a regular frequency. Standard wall outlets in the United States supply AC current.

AEV: All-Electric Vehicle. An AEV is a subcategory of electric vehicle (see EV definition below) and is any vehicle that operates exclusively on electrical energy stored in the vehicle's battery and produces zero tailpipe emissions or pollution when stationary or operating. AEV batteries are charged using an external source of electricity. Also known as a battery electric vehicle (BEV).

AFV: Alternative Fuel Vehicle. A dedicated, flexible fuel, bi-fuel (or dual-fuel) vehicle designed to operate on at least one alternative fuel (e.g., biodiesel, natural gas, propane, electricity, or ethanol).

ARRA: American Recovery and Reinvestment Act. Congress passed ARRA in 2009 in direct response to the economic crisis with the goal of saving existing and creating new jobs, spurring long-term economic growth, and fostering accountability in government spending. ARRA provided nearly $8 billion in tax reductions and funding for entitlement programs, grants, and loans.

Battery exchange station: A facility that enables an electric vehicle with a swappable battery pack to exchange a depleted battery pack for a fully charged battery pack, generally through an automated process. Other terms for a battery exchange station include battery switch station and battery swap station.

Charger: An electrical component assembly or cluster of component assemblies designed specifically to charge batteries or other energy storage devices within electric vehicles. Chargers include standardized indicators of electrical force, or voltage (see "Charging levels"), and may charge batteries by conductive or inductive means.

Charging: Term referring to the act of inserting a charger connector into an electric vehicle inlet in order to transfer electrical power to recharge the batteries on board the vehicle.

Charging levels: Standardized indicators of electrical force, or voltage, at which an electric vehicle's battery is recharged. They are referred to as Level 1, Level 2, and Level 3 (or DC/AC Fast Charging).

Circuit breaker: A device that automatically interrupts the flow of current in an overloaded electric circuit.

Consumer: An individual or organization that purchases, rents, or drives an electric vehicle.

Current: The flow of electricity (commonly measured in amperes).

DC: Direct Current. Electric current that moves in one direction from negative to positive. Batteries in electric vehicles provide direct current.

DOE: U.S. Department of Energy.

DOT: U.S. Department of Transportation.

DVRPC: Delaware Valley Regional Planning Commission.

Early adopters: Consumers who embrace new technology before the rest of the market. Early adopters are expected to make up the majority of electric vehicle purchases in southeastern Pennsylvania for the next several years.

Electric vehicle charging station: The space serviced by a charger, including all signs, information, pavement surfaces, surface markings, and protective equipment, in which the transfer of electric energy occurs by conductive or inductive means between the charger and the battery or other energy storage device in a stationary electric vehicle.

EPRI: Electric Power Research Institute. A utility-industry-based research group.

EREV: Extended Range Electric Vehicle. An alternate term for a plug-in hybrid electric vehicle, specifically referring to one designed to run in all-electric mode until the battery is depleted. It is considered by some industry observers to be a marketing term.

EV: Electric Vehicle. Any motor vehicle for on-road use that is capable of operating solely on the power of a rechargeable battery or battery pack (or other storage device that receives electricity from an external source, such as a charger) and meets the applicable federal motor vehicle safety standards and state registration requirements. Electric vehicles include, but are not limited to all-electric vehicles, plug-in hybrid electric vehicles, neighborhood electric vehicles, and electric motorcycles. Also known as a plug-in electric vehicle (PEV).

EVSE: Electric Vehicle Supply Equipment. Inclusive of all of the components for electric vehicle charging stations, including: the conductors; the ungrounded, grounded, and equipment grounding conductors; electric vehicle connectors; attachment plugs, and; all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of delivering energy from the grid to an electric vehicle.

FHWA: U.S. Federal Highway Administration. FHWA is a division of DOT that specializes in highway transportation.

GHG: Greenhouse Gas. Any of the gases (e.g., carbon dioxide, methane, ozone, nitrous oxide, and fluorocarbons) that contribute to the greenhouse effect by absorbing solar radiation once in the atmosphere. The dominant GHG is carbon dioxide, a primary product of the combustion of fossil fuel.

GPCC: Greater Philadelphia Clean Cities

HEV: Hybrid Electric Vehicle. A motor vehicle that is powered by both an electric propulsion system with a conventional internal combustion propulsion system and meets the applicable federal motor vehicle safety standards and state registration requirements. An HEV does not plug into an off-board electrical source.

IBC: International Building Code.

ICE: Internal Combustion Engine. An engine that uses the explosive power of combusting fuel inside a chamber as a means of delivering power.

INL: Idaho National Laboratory.

IRC: International Residential Code.

J1772: Industry-wide standard EV connector for Level 2 charging.

kW: Kilowatt. A unit of power equal to 1,000 watts.

kWh: Kilowatt-hour. A unit of energy, equal to one kW delivered per hour, commonly used for measuring the energy capacity of a battery. This is the normal quantity used for metering and billing electricity customers.

Li-ion: Lithium-ion. The chemical technology used in a majority of electric vehicle batteries at the time of this document's publication. Lithium-ion batteries are lighter in weight and have higher energy density than the batteries they replaced.

Likely adopters: Consumers who typically embrace new technology but may start investing in the technology after early adopters have proven its success.

MUD: Multi-Unit Dwelling. Housing in a single building with more than one discrete housing unit (e.g., an apartment building or duplex house). MUDs are also referred to as multi-family dwellings (MFDs) or multi-dwelling units (MDUs).

MUTCD: Manual on Uniform Traffic Control Devices. A document issued by FHWA of (DOT to specify the standards by which traffic signs, road surface markings, and signals are designed, installed, and used.

NEC: National Electric Code. A standard for the safe installation of electrical wiring and equipment in the United States. This code is sponsored and regularly updated by the National Fire Protection Association.

NEV: Neighborhood Electric Vehicle. An EV typically restricted to low-speed roads and powered solely by electricity. Also known as a low-speed vehicle.

NFPA: National Fire Protection Agency.

NiMH: Nickel metal hydride. The chemical technology for a battery type often used for HEVs.

NREL: National Renewable Energy Laboratory.

OEM: Original Equipment Manufacturer. For purposes of this report, OEM refers to EV manufacturers. Examples include General Motors and Nissan.

PA DEP: Pennsylvania Department of Environmental Protection.

PEV: Plug-In Electric Vehicle. Another common term for electric vehicle (see EV definition above).

Phase: Classification of an AC circuit; circuits are usually single-phase (two-, three-, or four-wire) or three-phase (three- or four-wire).

PHEV: Plug-in Hybrid Electric Vehicle. A type of electric vehicle (see EV definition above) that is powered by an ICE, as well as an electric motor, and is capable of being powered solely by electricity. PHEV batteries are primarily charged by connecting to the grid or another off-board electrical source, but may also be able to sustain battery charge using an on-board internal-combustion-driven generator.

Possible adopters: Consumers who invest in technology only after it has been proven by early and likely adopters.

PUC: Public Utility Commission. A state regulatory agency that governs retail utility rates and practices. Also known as Public Service Commission in some states.

SAE: SAE International, formerly the Society of Automotive Engineers. SAE International develops standards to create consistency in the design of EVs and the associated charging equipment.

TOU: Time-of-Use. An electricity billing method with rates based upon the time of usage during the day.

UCC: Uniform Construction Code. Pennsylvania's statewide building code.

V: Volt. A measure of electrical potential difference or pressure. One volt is defined as the electrical potential required to produce a current of one ampere across a one ohm resistance.

V2G: Vehicle-to-Grid. The concept of using EVs as energy storage devices for the electric grid.

VMT: Vehicle Miles Traveled.

Watt: A unit of power, defined as one joule per second, which measures the rate of energy transfer.

ZEV: Zero Emissions Vehicle. A vehicle that emits no tailpipe pollutants from the onboard source of power.

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Abstract:

Ready to Roll! Southeastern Pennsylvania's Regional Electric Vehicle Action Plan is a comprehensive, regionally coordinated approach to introducing electric vehicles (EVs) and electric vehicle supply equipment (charging facilities) into the five counties of southeastern Pennsylvania. This plan is the product of a partnership between DVRPC, the City of Philadelphia, PECO Energy Company (the region's electricity provider), and Greater Philadelphia Clean Cities. ICF International provided assistance to DVRPC with the preparation of this plan. The plan incorporates feedback from key regional stakeholders, national best practices, and research to assess the southeastern Pennsylvania EV market, identify current market barriers, and develop strategies to facilitate vehicle and infrastructure deployment.

Ready to Roll! is presented in two volumes, and is accompanied by an online information clearinghouse, containing links to additional resources. The first volume (this document) includes the regional readiness plan. The second volume (publication number 12055B) provides an in-depth analysis of a variety of EV and EVSE issues.

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