Clean Cities 2011 EV Community Readiness

Metropolitan Energy Information Center, Inc.

Kansas – Missouri Community Readiness for Electric Vehicle (EV) and Electric Vehicle Supply Equipment (EVSE)

PI: Kelly Gilbert, MEC

David C. Kirschner
U.S. Department of Energy
National Energy Technology Laboratory

May 15, 2013

Project ID: TI030

OVERVIEW

MEC: Clean Cities 2011 EV Community Readiness

Timeline

- Start: October 2011
- End: June 2013
- 92% Complete

Budget

- Total Project Funding:
  $ 441,478 (DOE: $441,478 / Cost Share: $0)
- Funded w/ FY11 & FY12 funds
- $406,132 spent (92% as of 02/28/2013)

Barriers Addressed

- Availability of Alternative Fuel Vehicles & Electric Drive Vehicles
- Availability of Alternative Fuels and Electric Charging Infrastructure
- Consumer Reluctance to Purchase New Technologies
- Lack of Technical Experience with New Fuels and Vehicle Technologies
- Uncertainty of transformer capacity for residential and commercial electricity distribution

OVERVIEW

MEC: Clean Cities 2011 EV Community Readiness

Partners

- Black & Veatch, a world leader in engineering and smart grid communications.
- Electrician's Training Center of IBEW Local Union 124 for delivery of EVITP technical training.
- Community colleges and universities: Kansas City Kansas Community College, Metropolitan Community College, Johnson County Community College, University of Kansas, University of Missouri – Kansas City, Pittsburg State University
- Polsinelli Shughart, PC: its Energy and Public Utilities law practice is a leading energy practice in the Midwest with widespread national experience
- Utilities: Westar and KCP&L
- State agencies in KS and MO: Kansas Corporation Commission, Missouri Public Service Commission, Departments of Transportation, Departments of Revenue
- Metropolitan Planning Agency: Mid-America Regional Council
- Municipalities: Cities of Wichita, Lawrence and Kansas City; Douglas County; Unified Government of Wyandotte County
- EV manufacturer: Smith Electric Vehicles
- EV and EVSE dealerships LilyPad EV, Olathe Ford
- Technical Advisor: Electric Power Research Institute

RELEVANCE

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Objectives

- Electrify Heartland will develop a plan with accompanying guidance documents, and wherever possible, execute planning elements to accelerate adoption of plug-in electric vehicles and charging infrastructure in the metropolitan areas of Kansas City, MO-KS; Wichita, Topeka and Lawrence/Douglas Co, KS.
- Work with regional stakeholders to inform the planning process and adapt planning documents to local audiences.
- Coordinate region-wide stakeholder outreach, conduct necessary research, and recommend model policy and planning approaches.
- Develop infrastructure deployment plans for light- and heavy-duty plug-in electric vehicles for both fleet and public use.

Project Supports VTP Deployment Goals

- By 2020, to achieve a petroleum reduction of over 2.5 billion gallons per year through voluntary adoption of alternative fuel vehicles and infrastructure.
- To ease market introduction of alternative fuels and new electric drive vehicle technologies through voluntary efforts in partnership with local communities
- To provide technical and educational assistance to support local communities and partnerships that promote better understanding of the benefits of these new technologies.

APPROACH

Statement of Project Objectives Tasks

Task 1: Project Management and Administration

- The recipient will manage the cost, schedule and scope of the project and provide status and progress to the Department of Energy in accordance with the deliverables section of this document.

Task 2: Planning

- The recipient will establish a stakeholder steering committee and task teams to evaluate Greater Kansas City Plug-in Readiness Strategy for completeness and establish planning goals and a schedule to achieve success. The recipient will analyze data, assemble information from the task teams and submit documents for peer review.

Task 3: Outreach and Training

- The recipient will work to establish electric drive technical expertise in area community colleges and develop technical training curriculum for EV auto technicians
- Work with regional Electric Vehicle Infrastructure Training Program to educate electricians about EVSE and consumers about knowledgeable electricians
- Create a project web site for consumer and municipal information, create consumer/operator EV and EVSE educational program, establish fleet outreach tactics and perform on-going identification of additional outreach and training needs

APPROACH

Statement of Project Objectives Tasks

Task 4: Implementation

- The recipient will set targets for successful implementation, engage community to implement recommendations through regional energy events, metropolitan planning organizations and small group meetings, identify opportunities to engage in events planned by other parties, conduct research and data analysis, provide training to appropriate audiences, and launch products

Task 5: Readiness Plan

- Activities in this task include drafting and completion of the final plan; submission of plan draft to project partners and stakeholders for review and comment; revision of draft plan according to stakeholder input and feedback as necessary; report of final plan to DOE.

MILESTONES

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Year 1

- Stakeholder outreach for directional feedback, December 2011
- Steering committee and task teams formed, January 2012
- Outreach program for project is named Electrify Heartland. Branding is developed for public communication tools, March 2012.
- Data gathering for work products, substantially completed July 2012
- Incorporate feedback on draft reports, July – October 2012
  - Comments from cross-team review, states, cities and stakeholders
- Outreach to promote project approach, April – October 2012

Year 2

- Completion of work products, December 2012
- Web publication of work products, March 2013
- Launch Electrify Heartland EV Coalition (Jan 2013), EV Ready Communities and EV Business Coalition (Apr 2013)
- Engage community to implement recommendations through regional energy events, metropolitan planning organizations and small group meetings
- Peer review with other award recipients, May 2013
- Completion of outreach events for stakeholders and metropolitan planning organizations, June 2013

Presentation: Why EV & EVSE?

- Given to 7 municipalities and 3 planning agencies in Kansas and Missouri, 3 Clean Cities coalitions and a number of outreach events.
- Using local data, the presenter estimated increased local spending potential if the population adopts EV at the rate of .4% of all consumer vehicle purchases.
- Presented other benefits of EV deployments and recommended steps toward readiness.

TECHNICAL ACCOMPLISHMENTS

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EVSE Corridor Analysis

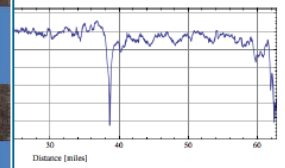
- Kansas is a flat state. We wanted to know how EV performance differed on a flat roadway versus mountainous areas, where other studies have been done.
- The analysis also recommends DC fast charging locations on the longest legs.

Regional Electric Vehicle Corridors

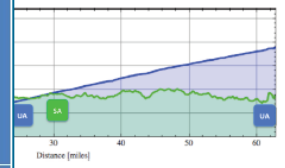
An Analysis for Missouri-Kansas

Prepared for the Kansas City Metropolitan Energy Center

Prepared by Logios



Kansas Corporation Commission to the Kauffman Center



the Kansas Corporation Commission to the Kauffman Center

Table 3 Charging scenarios on a trip from Wichita to Topeka

Stop	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	Time [1] (min)	SOC [2] (kWh)	Time (min)	SOC (kWh)	Time (min)	SOC (kWh)	Time (min)	SOC (kWh)
Towanda	9-13	24			5-9	20		15
Matfield Green	13-17	24	20-24	22	13-17	20	10-14	12
Emporia	12-16	24	12-16	22	13-17	21	18-22	18
Topeka	18-22	24	20-24	24	25-29	24	30-34	24
Minimum on-route charging time [3]	34		32		31		28	

[1]: Charge time using DC fast charge infrastructure

[2]: Energy stored in the battery after the charging event is completed

[3]: Total minimum time spent charging during stops, excluding time charging in Topeka

Alternative infrastructure host areas

Our data collection and analysis was predominantly focused on the case where charging infrastructure would be hosted at Turnpike service areas. We have shown that purely from a technological (vehicle and infrastructure) standpoint, the services areas could host an adequate charging station network that supports EV travel from Topeka to Wichita.

10 shows the three-dimensional topography along the trip between Kansas City and Topeka.

Our simulations suggest that EVs traveling from Kansas City to Topeka under the assumed conditions would use about 21 kilowatt-hours. Partly as a consequence of the difference in trip lengths, our simulations show that energy consumption on the trip back east is lower than on the trip west. The difference of approximately 2 kilowatt-hours can also be partially

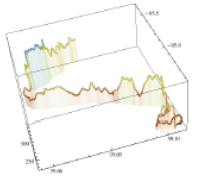


Figure 10 Three-dimensional representation of topographical elevations between Kansas City and Topeka

attributed to somewhat lower average speeds on the trip east back to Kansas City.

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TECHNICAL ACCOMPLISHMENTS

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EV Technician Training Curriculum

- Auto and electrical technicians from 4 regional colleges attended SAE training on Hybrid Electric and Battery Technology.
- Curricula were developed and a full-fledged hybrid electric program was launched at Kansas City Kansas Community College.

G. Automotive Technician Curriculum

Synopsis: This appendix to the Electrify Heartland Plan is a curriculum for a hybrid electric vehicle training program that was developed for a community college associate degree certificate.

Authors: Bob McGowan, Kansas City Kansas Community College

Course Numbers and Titles

AHEV 102	Course Title: Hybrid Electric Vehicle Safety for First Responders and Dismantlers
AHEV 203	Course Title: Basic Hybrid Electric Vehicles
AHEV 212	Course Title: Hybrid Electric Vehicle Internal Combustion Engines and Alternate Power
AHEV 222	Course Title: Hybrid Electric Vehicle Transmissions
AHEV 262	Course Title: Hybrid Electric Vehicle Batteries
AHEV 265	Course Title: Hybrid Electric Vehicle Accessories
AHEV 282	Course Title: Hybrid /Electric Vehicles Inverters, Converters and Electric Motors

The curriculum outline for each course is available on www.electrifyheartland.org and is provided in the project DVD.

SYLLABUS

DATE OF LAST REVIEW : Spring 2010

CIP CODE: 47.0614

SEMESTER: Departmental Syllabus

COURSE TITLE: Basic Hybrid Electric Vehicles

COURSE NUMBER:

CREDIT HOURS: 3

INSTRUCTOR:

OFFICE LOCATION:

OFFICE HOURS:

TELEPHONE:

EMAIL :

PREREQUISITE(S):
instructor.

REQUIRED TEXT AND
Please see bookstore for cur

COURSE DESCRIPTION
The student will learn basic
automobile. The content wi
inverter/converter operation
unique automobiles. The co
the deadly nature of the high
their own high voltage class

METHOD OF INSTRUC
A variety of instructional m
include but are not limited t
labs and demonstrations, pr
conferencing, performances
Methodology will be selecte

COURSE OUTLINE:
All students must comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

I. Introduction to Hybrid and Electric Vehicles
   - A. Series design
   - B. Parallel design
   - C. HEV technologies

II. High Voltage Electrical Safety
   - A. Electric shock
   - B. Tool and equipment usage and high voltage systems
   - C. Electrical isolation
   - D. Multimeters
   - E. CAT III

III. High Voltage Vehicle Safety Systems
   - A. Hybrid high voltage safety systems
   - B. Serial interlock loop
   - C. Service disconnect switch systems
   - D. Testing for isolation faults

IV. AC Motor Operation
   - A. Electric motor theory
   - B. Electric vehicle system components
   - C. The rotor and stator

V. Power Inverter and Converter Systems
   - A. Power inverter operation
   - B. The hybrid and electric power systems
   - C. Basic motor controls
   - D. Regenerative braking
   - E. DC-DC converters
   - F. Power generation

VI. Basic Electric Motor Sensing Systems
   - A. Motor speed sensing
   - B. Resolver
   - C. Motor load / current sensing
   - D. Throttle / brake pedal position sensing

VII. Transmission/Transaxles and Cooling Systems
   - A. Electric& planetary gear operation
   - B. Gear ratio blending between EM and ICE
   - C. Cooling systems

VIII. Energy Management Operation
   - A. High voltage fuse
   - B. Current sensing
   - C. Battery contactors
   - D. Battery cooling and temperature sensing

TECHNICAL ACCOMPLISHMENTS

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EVSE / EV Concentration Maps

- Using demographics of likely EV owners and activity centers, likely concentrations of EV and EVSE were mapped for the Kansas City metro, and similar work was done for Wichita, KS.

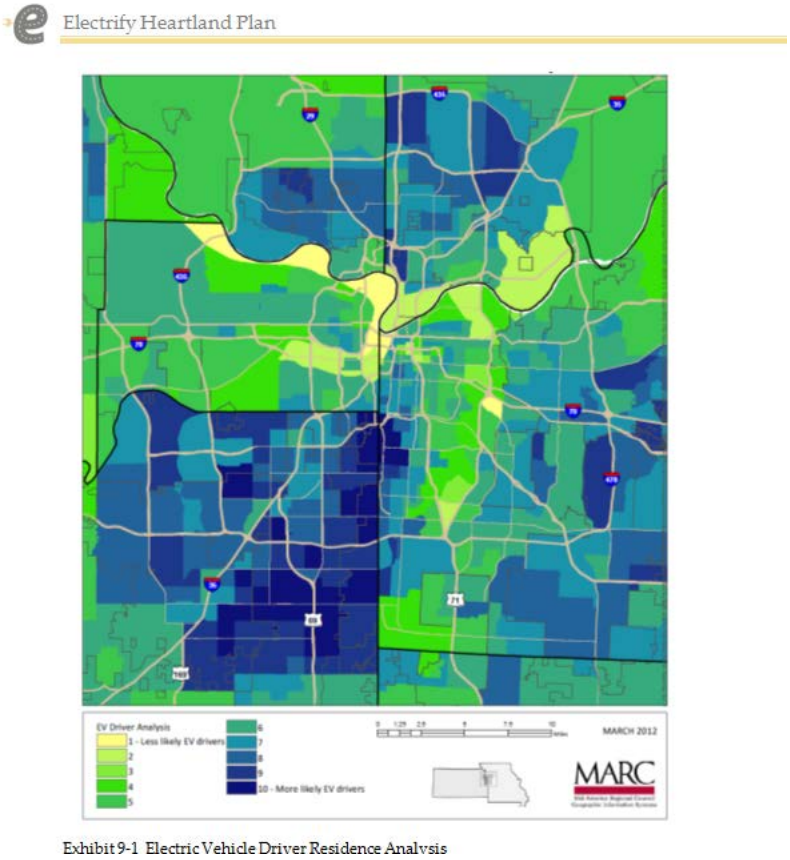

Exhibit 9-1 Electric Vehicle Driver Residence Analysis

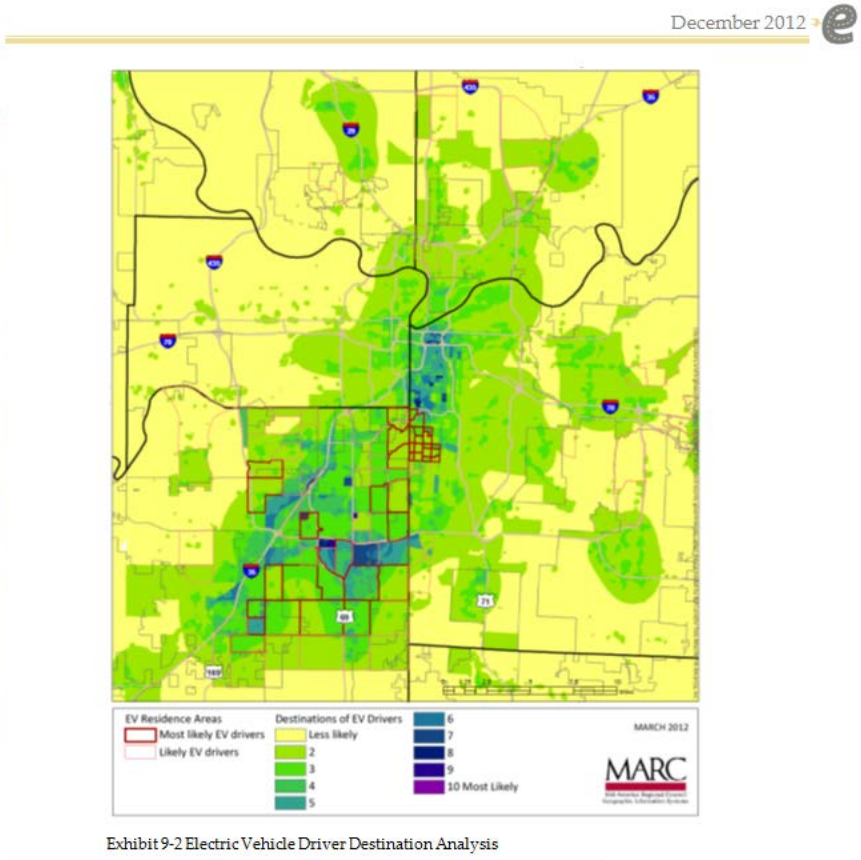

Exhibit 9-2 Electric Vehicle Driver Destination Analysis

TECHNICAL ACCOMPLISHMENTS

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Utility Grid Assessment

- EV penetration targets under the project were set to match the Administration's goal of 1 million EVs, which works out to about .04% of vehicles on roadways today.
- We developed a utility assessment model to test transformer capacity for residential and commercial electricity distribution.
- We found that target penetrations offered no worries whatsoever and discovered the weakest points in electricity distribution systems for future cases of higher EV penetrations.
- Scenarios tested were 1%, 20%, 40%, 60%, 80% and 100% penetration.

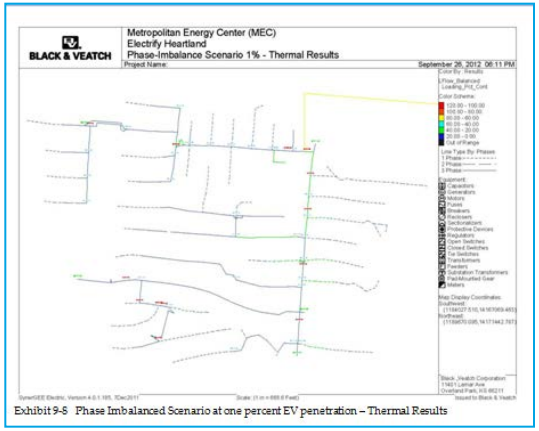


Exhibit 9-8 Phase Imbalanced Scenario at one percent EV penetration – Thermal Results

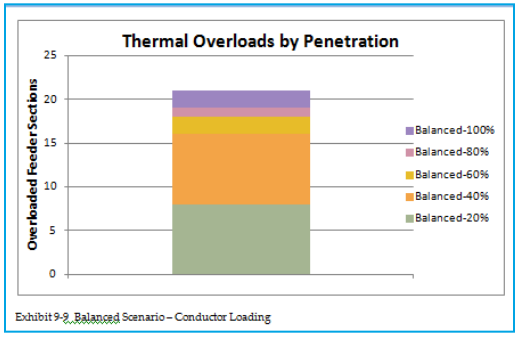


Exhibit 9-9 Balanced Scenario – Conductor Loading

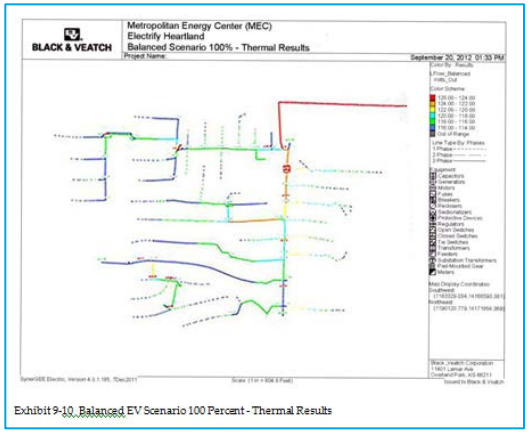


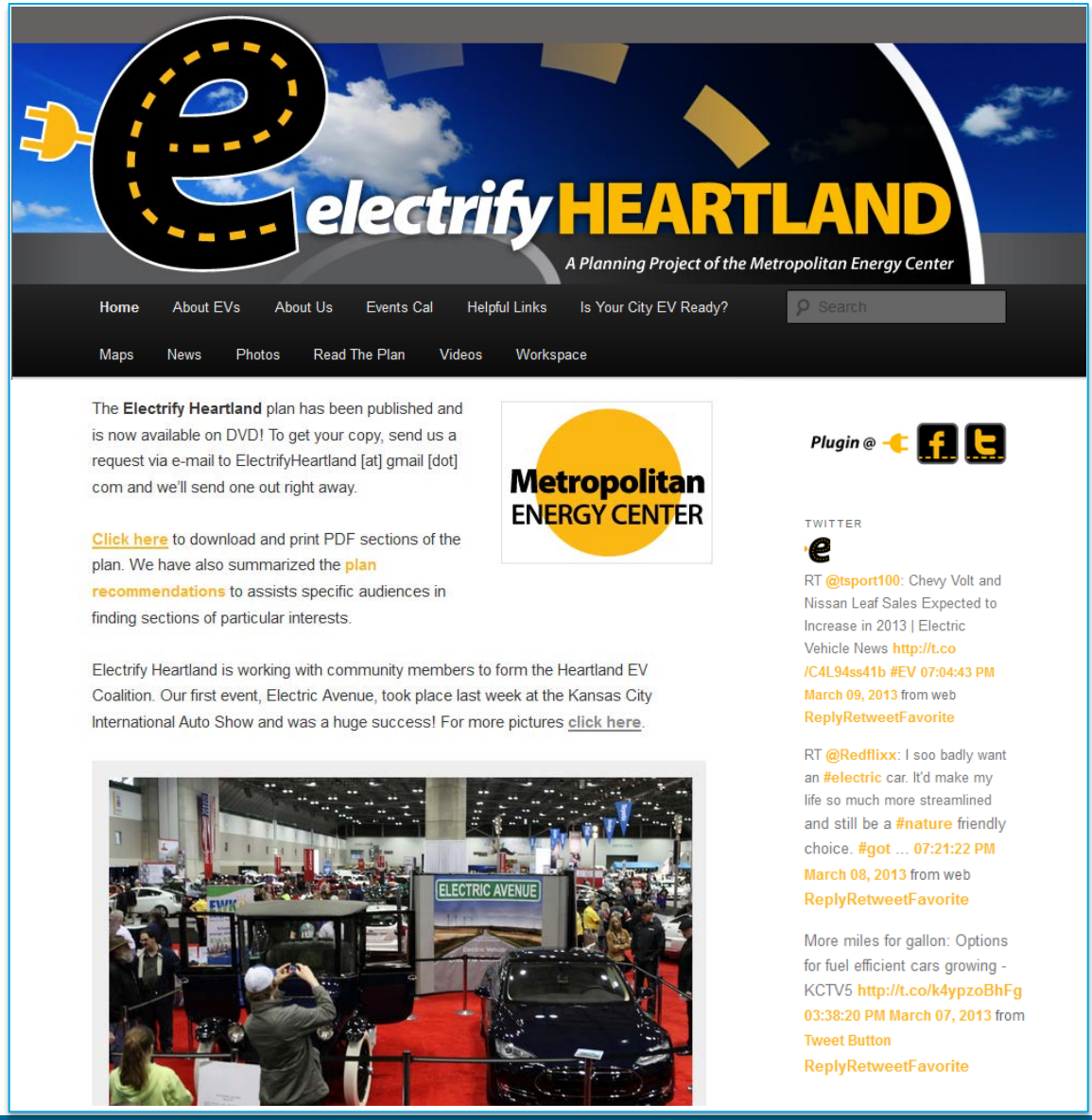
Exhibit 9-10 Balanced EV Scenario 100 Percent - Thermal Results

TECHNICAL ACCOMPLISHMENTS

MEC: Clean Cities 2011 EV Community Readiness

ElectrifyHeartland.org

- EV Ready Communities application
- DOE and AFDC resources
- Plan documents
- Photos and videos
- Consumer information
- Social media feeds
- More

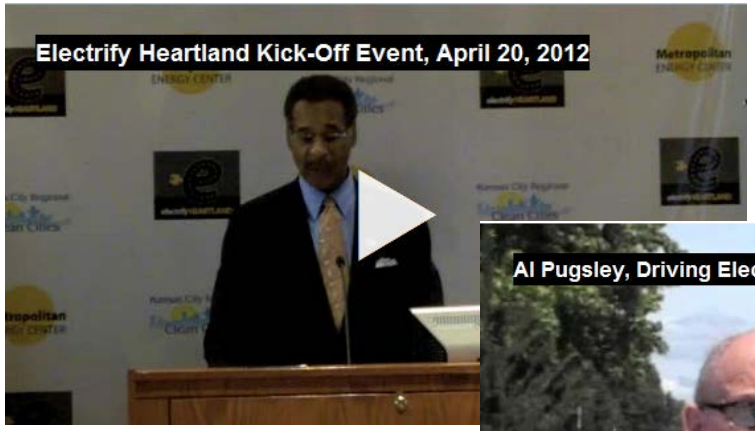


TECHNICAL ACCOMPLISHMENTS

MEC: Clean Cities 2011 EV Community Readiness

Why Buy Electric?

- Rearview mirror hangtag: One challenge to EV adoption is the support of vehicle dealerships. Why push EVs, if the salesman can move another car already on the lot? This hang tag can be put in display vehicles, to encourage customers to ask for EVs.



Online Videos

- Testimonials of EV drivers in the planning territory.
- Support from Congressman Cleaver.
- Coverage of events where EVs are exhibited and available for rides.

TECHNICAL ACCOMPLISHMENTS

MEC: Clean Cities 2011 EV Community Readiness

Deliverables

- EVSE Planning & Policy Tool Guidelines
- Assessment of EVSE & EV Deployment
- Development of Utility Assessment Model and Assessment of Utility Readiness

Work Products and Guidelines

- EV Ready Communities certificate program
- EV Business Coalition certificate program
- Automotive Technician Curriculum
- EVSE Corridor Analysis
- EV Fleet Tools
- “Why Electric Vehicles?” Rearview mirror hangtag
- EVSE Site Host Considerations
- Electricity – EV Air Quality Report for the planning region
- Website, social media, and videos

COLLABORATIONS

MEC: Clean Cities 2011 EV Community Readiness

Clean Cities Coalitions

- Kansas City Regional Clean Cities

State Agencies/Institutions

- Kansas Corporation Commission
- Missouri Public Service Commission
- Department of Transportation – MO
- Department of Transportation – KS
- Departments of Revenue – MO
- Departments of Revenue – KS

Educational Institutions

- Kansas City Kansas Community College
- University of Missouri – Kansas City
- Joint Apprenticeship Electrician Training Center of Kansas City

Local Governments/Agencies

- Metropolitan Planning Agencies
  - Mid-America Regional Council
  - Wichita Area Metropolitan Planning Organization
- Local Governments
  - City of Lawrence, KS
  - City of Wichita, KS
  - City of Topeka, KS
  - City of Kansas City, MO

Others

- Black & Veatch
- Polsinelli Shughart, PC
- IBEW Local 124
- Logios

SUMMARY

MEC: Clean Cities 2011 EV Community Readiness

- Metropolitan Energy Center has completed a wide range of guidance documents and stakeholder outreach and education to advance EV deployment in Kansas and western Missouri
- Best practices and guidelines documents are relevant to both the public and private sectors in this region
- Stakeholder outreach and engagement will continue past the end of the grant period
- The partnerships formed under this project will continue to push for adoption of these best practices in the region and will look for new ways to work together on EV deployment
- EV and EVSE deployment is continuing rapidly in the region and the guidance documents will play a major role in shaping future deployment efforts

PROPOSED FUTURE WORK

MEC: Clean Cities 2011 EV Community Readiness

- Major Project Activities for the Next Year
  - Launch EV Ready Communities and EV Business Coalition.
  - Engage community to implement recommendations through regional energy events, metropolitan planning organizations and small group meetings.
  - Engage state officials with EVSE corridor recommendations.
  - Continue outreach to stakeholders via exhibits, media releases and website.

Clean Cities 2011 EV Community Readiness

Delaware Valley Regional Planning Commission
Southeastern Pennsylvania Regional Electric Vehicle Infrastructure Planning
PI: Robert Graff

David C. Kirschner
U.S. Department of Energy
National Energy Technology Laboratory

May 15, 2013

This presentation does not contain any proprietary, confidential or otherwise restricted information.

Project ID: TI030

OVERVIEW

DVRPC: Clean Cities 2011 EV Community Readiness

- TIMELINE
  - Start: October 2011
  - End: June 2013
  - 90% Complete

- BUDGET
  - Total Project Funding:

    $ 387,698 (DOE: $ 387,698 / Cost Share: $0)
  - Funded w/ FY11 & FY12 funds
  - $ 321,944 spent (83% as of mid-February 2013)

- BARRIERS ADDRESSED
  - Availability of Alternative Fuel Vehicles & Electric Drive Vehicles
  - Availability of Alternative Fuels and Electric Charging Infrastructure
  - Consumer Reluctance to Purchase New Technologies
  - Lack of Technical Experience with New Fuels and Vehicle Technologies
- PARTNERS
  - DVRPC
  - Greater Philadelphia Clean Cities
  - PECO Energy
  - City of Philadelphia, Pennsylvania
  - Bucks, Delaware, Chester, and Montgomery Counties, Pennsylvania
  - Pennsylvania Department of Transportation
  - PA Dept. of Environmental Protection
  - Other DOE grantees (NYSERDA, NYCLHVCC)
  - Transportation and Climate Initiative

RELEVANCE

DVRPC: Clean Cities 2011 EV Community Readiness

Objective

The objective of this project is to create a community based electric vehicle infrastructure readiness plan and implement activities in anticipation of larger electric vehicle deployment efforts in the future.

Project Supports VTP Deployment Goals:

- By 2020, to achieve a petroleum reduction of over 2.5 billion gallons per year through voluntary adoption of alternative fuel vehicles and infrastructure.
- To ease market introduction of alternative fuels and new electric drive vehicle technologies through voluntary efforts in partnership with local communities
- To provide technical and educational assistance to support local communities and partnerships that promote better understanding of the benefits of these new technologies.

APPROACH

Statement of Project Objectives Tasks

Task 1: Project Management and Administration

- The recipient will manage the cost, schedule and scope of the project and provide status and progress in accordance with the deliverables section of this document.

Task 2: Information Gathering and Synthesis

- Develop a white paper describing opportunities and barriers and identifying the key issues surrounding the installation of EV charging infrastructure in the project region. The white paper will be developed using existing regional plans for deployment of EV charging infrastructure and national research highlighting the experience of other regions.

Task 3: Analyze Electric Drive Vehicle Demand

- Evaluate demand for household electric drive vehicles: Using a combination of vehicle trip characteristics, and an identification of likely early adopters of EVs, develop an estimate of the number and location of likely EV early adopters in the private residential market
- Evaluate the likely demand for fleet EVs in the project area through in-person interviews with fleet managers and analysis of available data on fleets.

APPROACH

Statement of Project Objectives Tasks

Task 4: Analyze Charging Infrastructure Requirements

- Evaluate the parking type availability for likely EV purchasers.
- Identify the most suitable locations for publicly-accessible EVSE
- Identify approaches for providing EVSE to serve EV owners that do not have dedicated off-street parking.
- Analyze costs of EVSE acquisition, installation, and operation.

Task 5: Analyze Issues for Integrating Electric Vehicles with the Grid

- Evaluate the impact of EVs on the project area's electricity generation, transmission, and distribution infrastructure

Task 6: Develop a Regional Regulatory Scheme and Incentive Structure

- Develop a regionally-consistent regulatory scheme for zoning, permitting, interconnection agreements, signage and enforcement
- Develop a plan for local benefits and incentives.

Task 7: Readiness Plan

- Develop and finalize a community based electric vehicle infrastructure readiness plan encompassing all components of the project which contains and addresses, at a minimum, the critical elements 6-10 identified in Appendix 1, Sample Plan Outline, of the Funding Opportunity Announcement DE-FOA-0000451.

MILESTONES

DVRPC: Clean Cities 2011 EV Community Readiness

Year 1

- October 2011: Kickoff meeting with project partners
- December 2011: Lead EV Session at TCI meeting in Washington DC, together with Adam Ruder of NYSERDA and Christina Ficicchia of NYCLHVCC
- February 2012: Select and contract with ICF International for technical support
- February 2012: Host *Garage-Free Summit*. Participants include Boston, NYC, Philadelphia, Baltimore, DC, GM, Nissan, Tesla, Coulomb, ECOtality, and utilities to discuss charging issues for those without dedicated off-street parking.
- April 2012: Receive address and vehicle type information for 2,225,595 passenger vehicles registered in 5 counties of SE PA.
- April 2012: First of three meetings with external stakeholder advisory group
- June 2012: Preliminary data analysis complete; literature review complete
- September 2012: Outline of readiness plan completed

Year 2

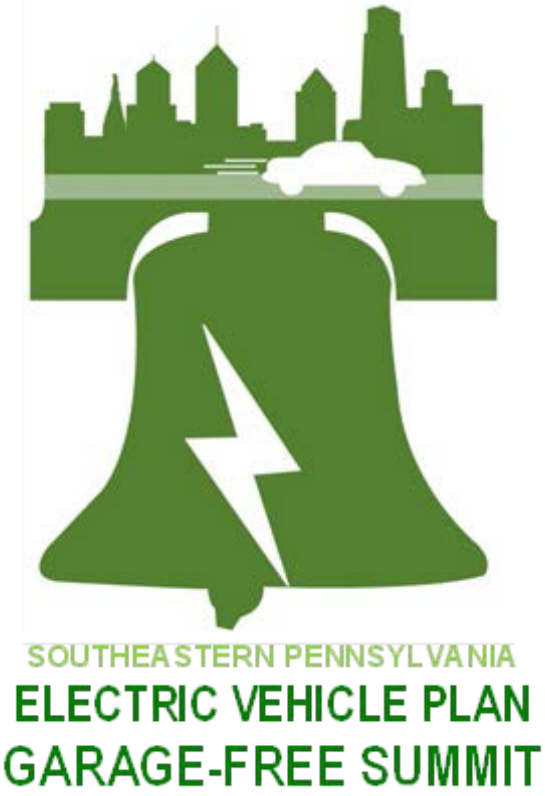
- November 2012: Draft readiness plan completed
- April 2013: Final readiness plan completed for DOE
- May 2013: Presentation and peer exchange with other award recipients
- June 2013: All documents on-line. DVRPC final document published.

TECHNICAL ACCOMPLISHMENTS

DVRPC: Clean Cities 2011 EV Community Readiness

Deliverables/Products completed:

- Stakeholder advisory group created and engaged
- Literature review completed and documented
- *Garage-Free Summit* held and documented
- Preliminary assessment of EV home and work locations provided to The EV Project for their work in the Philadelphia Region (started August 2012)
- Guidance for municipalities prepared and presented in Readiness Plan

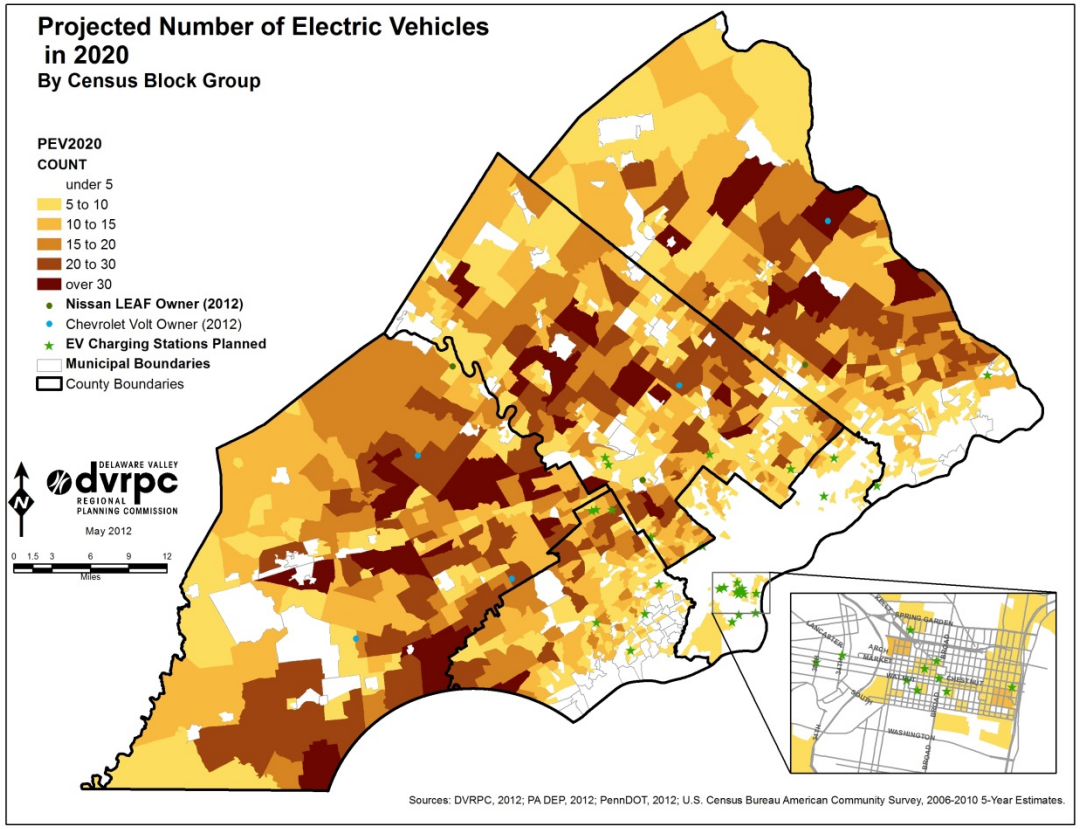


TECHNICAL ACCOMPLISHMENTS

DVRPC: Clean Cities 2011 EV Community Readiness

Analytical methodology to locate likely EV owners

- Vehicle Registration Data
- HEV ownership
- Household income
- Informed by research at UC Davis

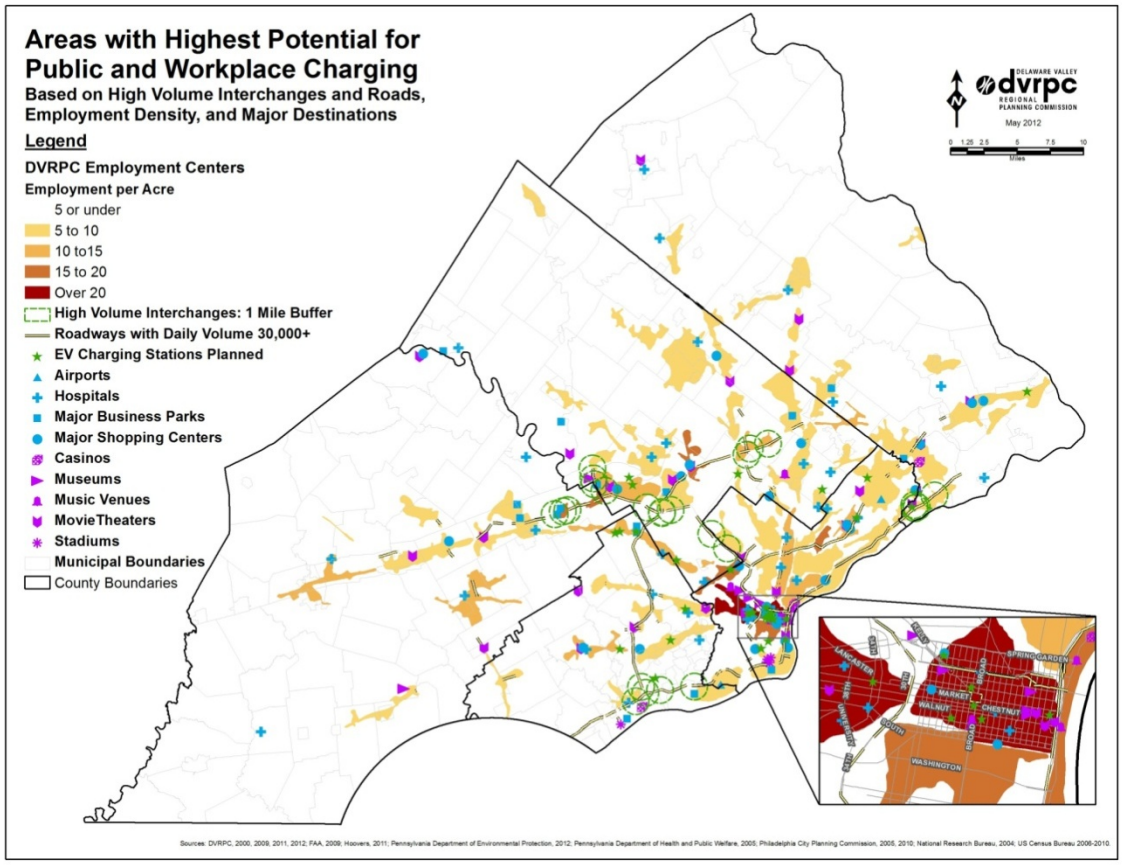


TECHNICAL ACCOMPLISHMENTS

DVRPC: Clean Cities 2011 EV Community Readiness

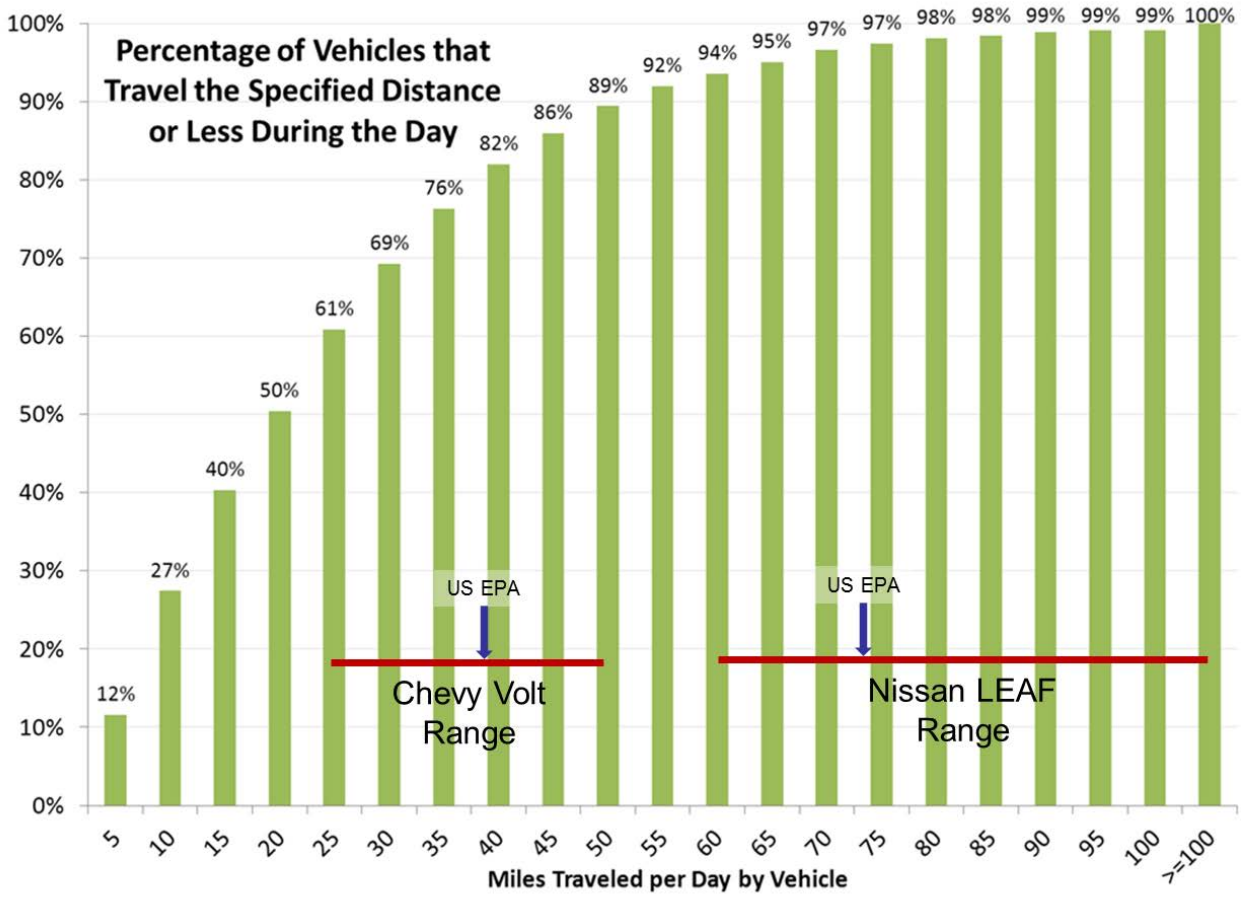
Analytical methodology to identify locations for public EVSE

- Employment density
- High volume interchanges
- Key public venues with longer average visits



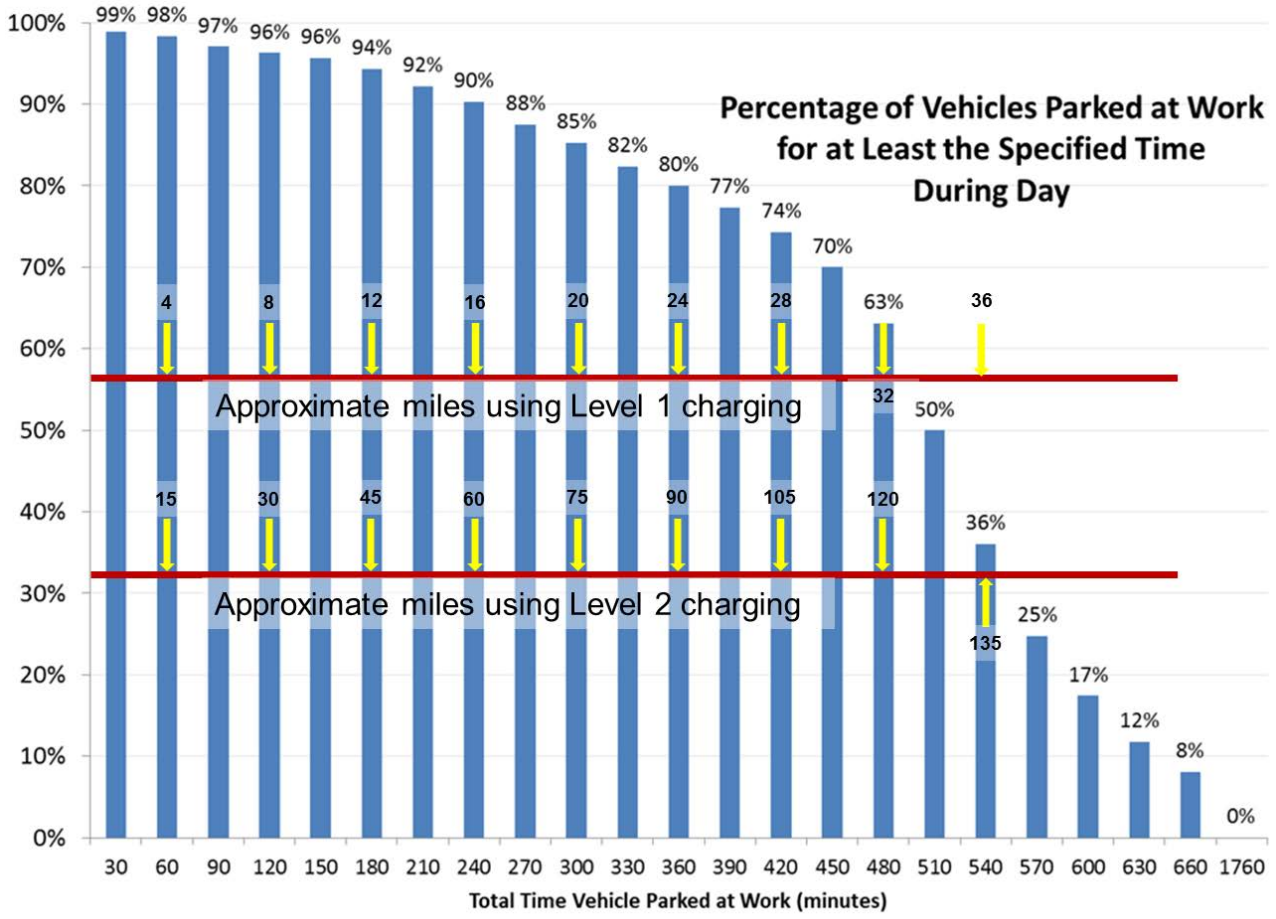
Methodology to assess EVs' ability to meet mobility needs

- Regional household survey
- Daily vehicle use



Methodology to assess EVSE needs at the workplace

- Regional household survey
- Time spent parked at work

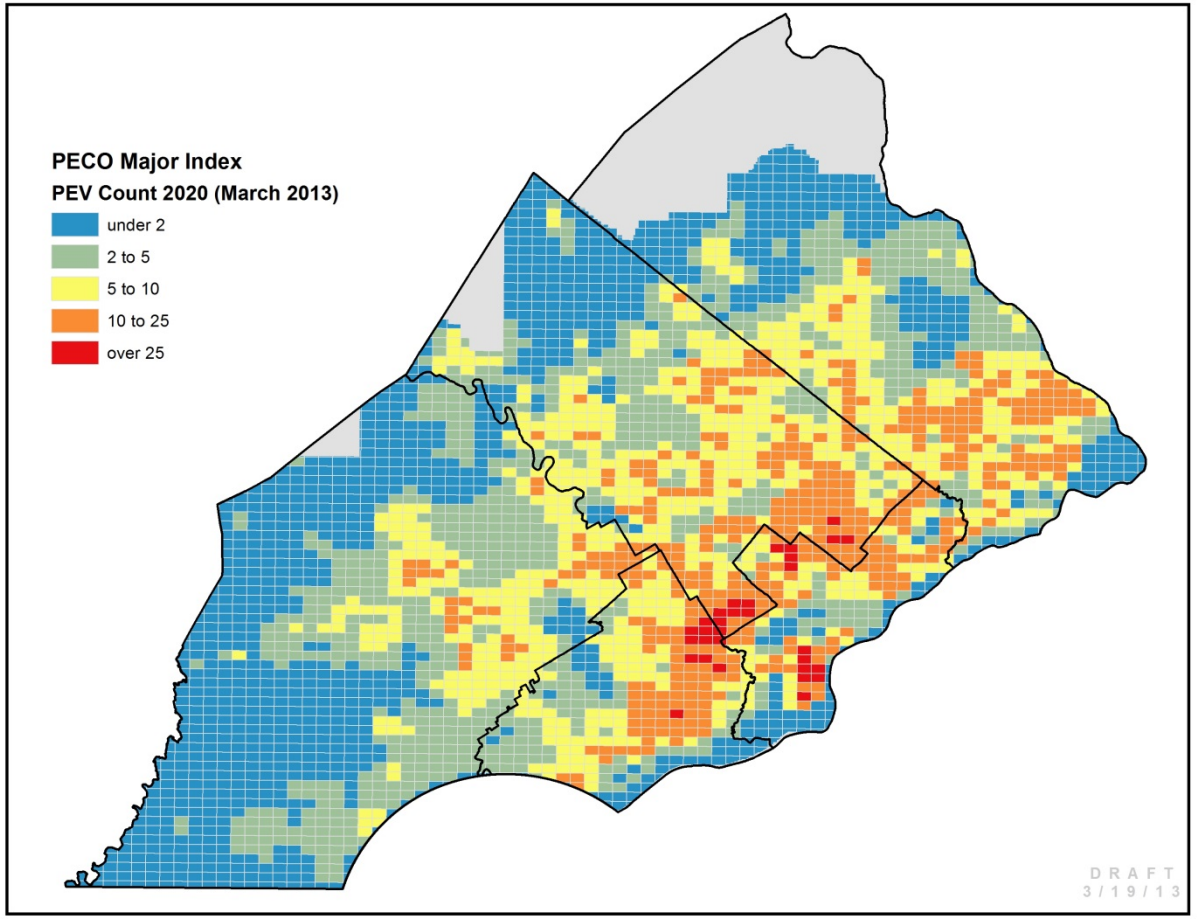


TECHNICAL ACCOMPLISHMENTS

DVRPC: Clean Cities 2011 EV Community Readiness

Methodology to assess electric grid readiness

- Translated projected EV ownership data to PECO electricity grid geography
- Worked with PECO to evaluate possible impacts of EV charging on the electrical grid.



COLLABORATIONS

DVRPC: Clean Cities 2011 EV Community Readiness

- GPCC
- NYCLVHCC
- NYSERDA
- TCI
- Georgetown Climate Center
- PECO Energy
- City of Philadelphia
- Bucks County
- Chester County
- Delaware County
- Montgomery County
- Pennsylvania Department of Environmental Protection
- Pennsylvania Department of Transportation
- The Electrical Association of Philadelphia
- ECOtality
- Chester County Economic Development Council
- Building Owners and Managers Association
- Various Fleet Managers

PROPOSED FUTURE WORK

DVRPC: Clean Cities 2011 EV Community Readiness

- Potential to use Longitudinal Household-Employment Dynamics data to improve workplace charging analysis
- Make use of TCI/NYSERDA research and materials to build EV momentum in DVRPC region
- Clean Cities Coalitions are continuing their outreach to stakeholders using the materials developed in this project
- Continue to press for adoption of better local rules and regulations for EV infrastructure

SUMMARY

DVRPC: Clean Cities 2011 EV Community Readiness

- DVPRC has completed a comprehensive analysis of the potential for increased EV deployment in SE Pennsylvania
- DVRPC has developed specific, transferable, methods to analyze and project key aspects of EV ownership, EVSE demand, and impact on the electrical grid.
- DVRPC has developed an outreach plan to provide recommendations to municipalities in SE PA for easing the installation of EVSE