



PLUG-IN ELECTRIC VEHICLE (PEV) ROADMAP FOR NORTH CAROLINA



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TEMPLATES AND PROCESSES FOR STATE ROADMAP

The templates for the Community Planning process were provided through previously developed tools from the North Carolina Get Ready program administered by Advanced Energy. Funding from the U.S. Department of Energy for the North Carolina PEV Readiness Initiative: Plugging in from M2S was used to customize the tools including the Community Planning Matrix, the PEV Initiative Paper and other documents for the Community PEV Readiness Plans. All planning tools used during the development of the Community Plan are included in the appendix of this document.

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COMMON TERMS

Acronym	Term
ADA	Americans with Disabilities Act
COG	Council of Government
CPM	Community Planning Matrix
EPRI	Electric Power Research Institute
EVSE	Electric Vehicle Supply Equipment, commonly referred to as Charging Station
ICE	Internal Combustion Engine
kWh	Kilowatt Hour
MPO	Metropolitan Planning Organization
NCDOT	North Carolina Department of Transportation
NCDMV	North Carolina Division of Motor Vehicles
NCSEO	North Carolina State Energy Office
NCSU	North Carolina State University
NEC	National Electric Code
PEV	Plug-in Electric Vehicle
TCCC	Triangle Clean Cities Coalition
TJCOG	Triangle J Council of Governments

Term	Definition
Charging Station	Device that transfers power to a PEV while providing proper grounding, shock protection, overload protection and general communication ¹ .
Electric Vehicle Supply Equipment (EVSE)	The official term for electric vehicle charging infrastructure, more commonly referred to as charging stations.
Internal Combustion Engines	Generate mechanical power by burning a liquid fuel (such as gasoline, diesel, or biofuels) or a gaseous fuel (such as a compressed natural gas). They are the dominant power source used in on-road vehicles today ² .
Plug-in electric vehicles	Derive all or part of their power from electricity supplied by the electric grid. Common examples include the Nissan LEAF, and Chevy Volt.

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EXECUTIVE SUMMARY

The North Carolina Plug-in Electric Vehicle (PEV) Roadmap is the first state-wide readiness plan addressing PEV adoption. Many stakeholders assisted with contributing to this plan, and as such, this plan is geared to a variety of audiences. Recommendations are included in this plan for:

- State, regional, and local governments and elected officials
- Academia, including universities, colleges, community colleges and K-12 programs
- PEV Industries and Industry Associations
- Non-profits, research and consulting industries
- Civic, environmental and advocacy groups
- General public

The NC PEV Taskforce and partners in the NC PEV Readiness Initiative: “Plugging-in from Mountains to Sea (M2S)” are responsible for plan education and awareness and the monitoring of implementation of the plan. The NC PEV Roadmap is not being adopted by a state-wide decision making body, instead, the Roadmap is designed to serve as a guide where the implementation is completed through the stakeholders of North Carolina. This approach is reflected in the plan’s recommendations, which provide examples on how stakeholders can help to implement the plan. All recommendations are suggested actions for PEV readiness and should not be considered mandatory.

The U.S. Department of Energy (DOE) funded effort, “NC PEV Readiness Initiative: Plugging-in from Mountains to Sea (M2S),” provided resources for members of the NC PEV Taskforce with contributions from the five Taskforce working groups to create the NC PEV Roadmap. In a parallel effort, the M2S project included the development of four community PEV readiness plans in the Asheville, Charlotte, Piedmont Triad and Triangle regions. Information and findings were routinely shared between the state planning and community planning efforts and the plans have been designed to cross reference each other throughout each document.

Key Accomplishments and Findings

The NC PEV Taskforce approached PEV readiness planning through a structured process where five individual working groups covered specific topics. The U.S. DOE’s suggested areas for review were worked into each working group’s set of tasks.

Stakeholders

Stakeholders for the NC PEV Roadmap were organized through the NC PEV Taskforce. Interested parties were able to participate in a variety of ways through attending the quarterly taskforce meetings, the monthly working group meetings. In addition to participating in the state-wide readiness plan, stakeholders could participate in one or more of the community readiness plans. Engaged stakeholders consisted of state and local governments, elected officials, electric utilities, local fleet managers, PEV industries, Clean Cities Coalitions, local media, non-profits, civic groups, local businesses, universities and colleges, community colleges and local property owners and developers.

Key findings from Stakeholder involvement included:

- Benefits provided by PEV adoption could help to address existing goals from various organizations (e.g., air quality, public health, reduced dependence on petroleum, economic development, etc.);
- Engaged stakeholders are key to implementation; and
- The NC PEV Roadmap will need to be widely released in order to ensure the maximum amount of participation and implementation.

Vehicles (Chapter Three)

Triangle J Council of Governments led the Vehicles Working Group which documented the long history that North Carolina already has with PEV activities including hybrid electric school bus projects and active electric vehicle enthusiast groups. The Vehicles Working Group worked with the NC Division of Motor Vehicles to collect data on registered PEVs in North Carolina (see map below). Moving forward, the Vehicles Working Group recommends to:

- Partner with key organizations such as the Electric Power Research Institute (EPRI), auto manufacturers and work collaboratively through the NC PEV Taskforce;
- Maintain and build on partnerships established with the NC Department of Motor Vehicles (NCDMV) to collect regular updates on registered electric vehicles; and
- Work through collaborative efforts to such as Clean Cities Coalitions to build business cases for fleet managers.

Registered Plug-in Electric Vehicles in North Carolina by County (August 2012)

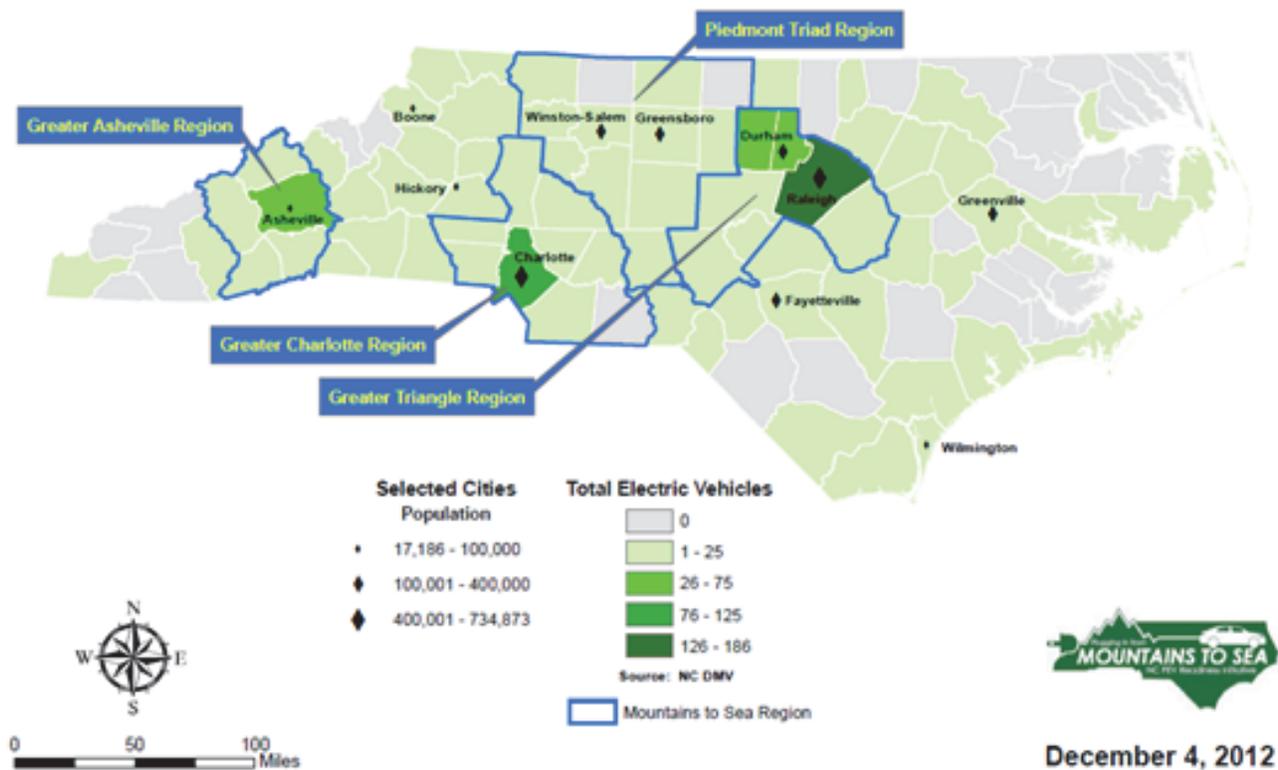


Figure 1 Registered Plug-in Electric Vehicles in North Carolina by County, August, 2012. The boundaries of the community PEV readiness plans are highlighted in by the blue line. Map created by Land-of-Sky Regional Council

Infrastructure (Chapter 4)

Members of the Infrastructure Working Group, led by Duke Energy Carolinas and Progress Energy Carolinas, covered several topics related to charging station considerations including identifying and mapping all public and private charging station installations in the state, collecting cost data for installations of charging stations, documenting best practices, and provide guidance for macro and micro installation considerations. The following include key points and observations:

- Based on existing charging station installations, North Carolina is well positioned for early adoption of PEVs. Data collection found that there are already 355 public and 176 private charging points at 228 locations throughout the state (see map below).
- There is still more work that needs to be done to address charging access, reduce costs and complexity and develop business models.
- The cost of installing charging stations can vary widely depending on many factors including location, charging station options, site features, permitting fees.
- Flowcharts were developed for residential, commercial, and workplace scenarios to help decision makers choose which power level is best suited to their application (AC Level 1, AC Level 2, DC Fast Charging).
- Considerations of future charging needs to implement and address a more fully developed plug-in electric vehicle market. Projections were made utilizing modeling developed through the Electric Power Research Institute (EPRI).

All Charging Sites in North Carolina (August 2012)

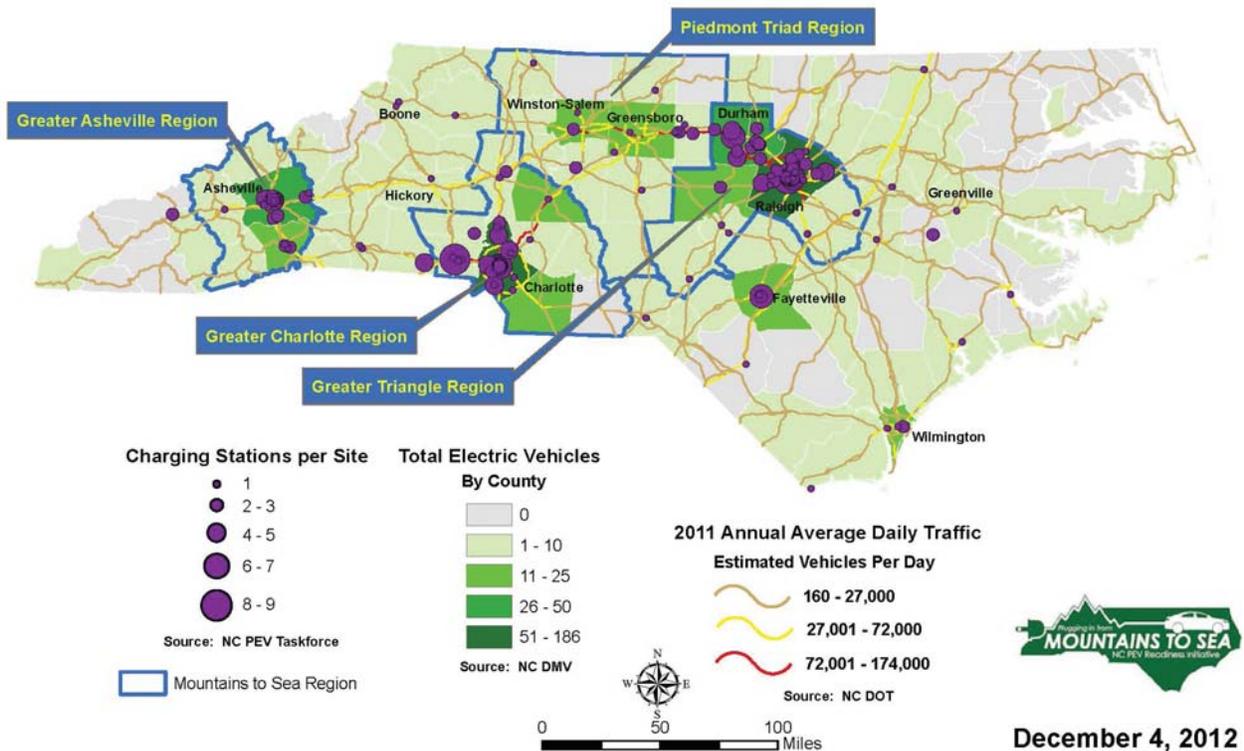


Figure 2 Registered Plug-in Electric Vehicles in North Carolina by County, August, 2012. The boundaries of the community PEV readiness plans are highlighted in by the blue line. Map created by Land-of-Sky Regional Council

Policies, Codes and Standards (Chapter 5)

Centralina Council of Governments led the Policies, Codes and Standards Working Group to explore policy considerations at the state, regional and local level. Members of this working group heard from state and national leaders in PEV readiness. Key findings from this group included:

- Recommending state and federal guidance for Americans with Disabilities Act (ADA);
- Recommending local governments to explore adopting municipal codes to regulate parking at electric vehicle charging stations;
- Recommending local governments to review and consider adopting revised zoning and historic district regulations to specifically cover electric vehicle charging stations; and
- Reviewing leading municipal permitting processes for electric vehicle charging stations. The Charlotte/Mecklenburg permitting office can process permits for residential charging station installations immediately through their online permitting systems.

Education and Outreach (Chapter 6)

The Education and Outreach Working Group, led by Advanced Energy, focused on four key topic areas including: education, outreach, training, and marketing. They recognized that messaging will vary depending on the audience, so key messages were developed for target audiences in North Carolina. As the working group covered the topic areas they documented key findings for the NC PEV Roadmap. A few examples are listed below:

- The NC PEV Taskforce can serve as a resource to North Carolina by developing and providing resources to community champions;
- Develop training materials to reach the local workforce, including: first responders, installers, inspectors, auto mechanics, fleet managers;
- Engage media outlets in PEV readiness planning and initiatives;
- Coordinate with organizations who can reach key audiences. Examples include schools, museums and training centers; and
- Explore hiring a marketing firm to help create and implement a state-wide PEV awareness campaign.

Incentives and Economic Development (Chapter 7)

The North Carolina Solar Center/NC State University and The North Carolina Department of Commerce led the Incentives and Economic Developing Working Group. This working group focused on increasing the state's economic development opportunities through vehicle electrification and also researched key incentives which could boost PEV adoption. Key findings and accomplishments of this working group included:

- Documenting existing PEV industries in NC and hosting two roundtable meetings with industries;
- Creating and administering a survey to identify which types of incentives would be most beneficial to fleet managers; and
- Creating an incentives paper which includes an analysis of state incentives in the southeast and providing recommendations for incentives for North Carolina (incentives paper included in the appendix of this plan).

Electric Utility Considerations (Chapter 8)

All electric utilities are a key stakeholder in the preparedness for PEVs. North Carolina enjoys the benefit of actively engaged and progressive electric utilities. In preparation of the NC PEV Roadmap, each utility partner assisted with providing content for the development of the NC PEV Roadmap. The utilities coordinated the PEV planning efforts by providing information for incorporation into a matrix. Key findings from the utility involvement are listed below:

- The utilities are each actively engaged in PEV planning through research based projects and policy planning.
- The utilities are providing resources to rate payers in the state on electric vehicle considerations through public outreach and educational programs.

Conclusion

Moving forward, the North Carolina stakeholders will ultimately implement the NC PEV Roadmap. Because this document is not being adopted by a decision making body, it should not be considered a mandate. Instead, the NC PEV Roadmap is designed to serve as a guide for PEV readiness for the state. The NC PEV Taskforce will continue to engage stakeholders and will routinely monitor the state for implementation.

INTRODUCTION



1

INTRODUCTION

With more than 9.6 million residents, North Carolina is ranked the 10th most populous state in the country³. North Carolina has experienced high growth rates in recent years, more than 18.5 percent which is twice the national average⁴, and projections anticipate a continued population increase. The Office of State Budget and Management project the population to increase to more than 11.6 million by the year 2030⁵.

The high growth rates are undoubtedly due in part to the state's many quality of life benefits including a moderate climate, excellent educational institutions, quality health care, nearby recreation and tourism opportunities, and a low cost of living⁶. All of these reasons make NC is a great place to live and work. Similar factors have placed North Carolina as one of the leading states in the nation in plug-in electric vehicle (PEV) readiness, with nationally recognized leading cities such as the Cities of Raleigh, Durham and Charlotte.

Raleigh, which was one of the first three cities invited to join Project Get Ready, a Rocky Mountain Institute Initiative, was noted as a "prime target for readiness" because of having:

- A progressive utility;
- University presence;
- Ready and willing local government leaders; and
- Proximity to Research Triangle Park.

(Source: City of Raleigh Brochure for Project Get Ready Activities)

Purpose of the North Carolina PEV Roadmap

The NC PEV Roadmap is intended to serve as a comprehensive guide to prepare North Carolina for the adoption of PEVs and contains recommendations for multiple stakeholders, all of which have a distinct sphere of influence in which they can produce recommendations.

Vision and Implementation

The following addresses the intended use of the NC PEV Roadmap as a resource and guide for implementation.

Vision

The NC PEV Roadmap serves as both an analysis of existing conditions and provides a vision of how the state can move towards PEV readiness.

Implementation

The recommendations in the Roadmap provide examples of how local and state stakeholders can help to implement the plan. Because the plan is geared towards many stakeholders, implementation will occur through outreach and monitoring implementation activities.

The NC PEV Roadmap was created by the NC PEV Taskforce and funded through the U.S. DOE grant for PEV planning titled "NC PEV Readiness Initiative: Plugging-in from Mountains to Sea." The Roadmap is a comprehensive PEV readiness plan for the state and is intended to be publicly releasable and replicable. As such, all processes and tools for creating the Roadmap have been documented and included in the plan. The NC PEV Roadmap intends to:

- Provide a structured approach to preparing the state for PEV readiness;
- Build on ideas and initiatives from participants in the plan development process;
- Ensure successful adoption and implementation of electric vehicle initiatives; and;
- Motivate stakeholders in NC to engage in PEV initiatives.



North Carolina PEV Taskforce

The NC PEV Taskforce was established in 2011 as an initiative of the North Carolina Department of Commerce and Advanced Energy to serve as a collaborative stakeholder led initiative to help accelerate the adoption of PEVs in NC. The Taskforce and its five working groups researched and contributed to the individual sections of the state readiness plan.

NC PEV Readiness Initiative: Plugging-in from Mountains to Sea (M2S)

In the fall of 2011, the NC PEV Readiness Initiative: Plugging-in from Mountains to Sea (M2S) was launched due to a grant from the U.S. DOE for PEV readiness planning. The grant enabled the creation of five PEV readiness plans including:

- A State-wide Roadmap for North Carolina; and
- Four Community Readiness Plans in the Asheville, Charlotte, Piedmont Triad and Triangle Regions.

The State Roadmap and the four Community Readiness Plans can be found at the Taskforce website www.NCPEVTaskforce.org.

Organization of this Plan

Research and findings from the NC PEV Taskforce and the five working groups make up the individual sections of the NC PEV Roadmap. While completing the plan, working group leads developed task lists, which incorporated elements from the U.S. DOE's recommendations for PEV planning. Each section of the plan was completed by the working group leads/M2S project partners associated with the topic area, and the sections provide an overview of the working group process, research and recommendations.

Sections of the Plan

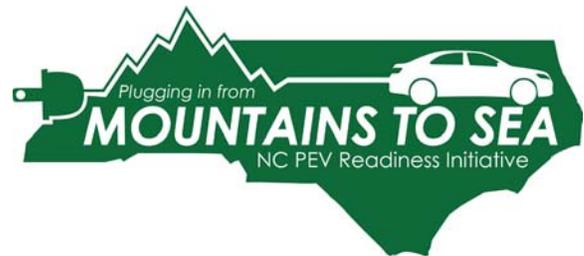
The Community PEV Readiness Planning process involved engaging community stakeholders to explore five different work areas associated with preparing for PEV adoption:

1. Vehicles
2. Infrastructure
3. Incentives and Economic Development
4. Policy, Codes and Standards
5. Education and Outreach

Other sections of the plan include a review of stakeholder involvement, an analysis of barriers, an overview of utility preparedness activities and plan recommendations.

Goals of the NC PEV Taskforce:

- Identify and address barriers to PEV adoption
- Involve existing and potential industry partners
- Recruit new industry
- Prepare NC to take advantage of future funding opportunities related to PEVs
- Create a PEV roadmap for NC to document Taskforce progress and recommend policy options



North Carolina's History and Background with PEVs

Although the NC PEV Roadmap is the first state-wide readiness plan for PEVs, there is a long history of electric vehicle readiness activities and initiatives, including:

- **Advanced Energy**

Advanced Energy is a North Carolina-based non-profit organization founded by the NC Utilities Commission to investigate and implement energy conservation initiatives. Advanced Energy's Transportation Division is committed to help communities understand, plan for and implement emerging transportation considerations.

- **Electric Utilities**

The electric utilities in NC have had a long history in electric vehicle readiness. A full list of these readiness activities can be found in Chapter 8.

- **Clean Cities**

The National Clean Cities Programs through the U.S. DOE works to improve air quality and reduce dependence petroleum by promoting alternative fuel vehicles through more than 100 local coalitions throughout the nation. There are currently three Clean Cities Coalitions in North Carolina:

- **Triangle Clean Cities Coalition (TCCC)**

- "Triangle Clean Cities Coalition is comprised of local & state government agencies, private companies, non-profit organizations, and interested individuals who are dedicated to accelerating the use of alternative fuels and advanced transportation technologies to improve air quality and energy security in the greater Triangle Region of North Carolina⁷."

- **Centralina Clean Fuels Coalition (CCFC)**

- "The Centralina Clean Fuels Coalition (CCFC), has been in existence in the Greater Charlotte Region for over 10 years and was designated in April of 2004 in the Department of Energy's Clean Cities program⁸."

- **The Land-of-Sky Clean Vehicles Coalition (LOSCVC)**

- "Created in 2004 to reduce petroleum use in the Asheville, NC metro area's transportation sector, primarily by promoting cleaner, domestic fuels and vehicles, it became the 85th designated Clean Cities coalition in the nation on July 26, 2012. The LOSCVC serves a five county area in western North Carolina, including Buncombe, Haywood, Henderson, Madison and Transylvania counties. It is housed at the Land of Sky Regional Council, which is the Council of Governments for the Asheville region. It has more than 100 stakeholders including the Eaton Corporation, Brightfield Transportation Solutions and other entities promoting electric drive transportation. The PEV Committee developed the Asheville Area PEV Plan in 2012 that lays out strategies for accelerating PEV adoption in the region⁹."

- **NC Solar Center/NC State University**

The mission of the NC Solar Center's Clean Transportation Program is to "increase the use of alternative fuels and advanced transportation technologies. Working with government, non-profits and businesses, the Clean Transportation team is helping diversify fuel supplies and support cleaner, more vibrant local and state economies¹⁰."

- **North Carolina's Research Triangle Clean Tech Cluster (RTCC)** (Information provided by RTCC)

"RTCC was formed to market and expand the region's presence in cleantech, particularly smart grid, advanced transportation, water technologies, renewable energy and energy efficiency. The RTCC's three-fold mission is to: innovate to make the Research Triangle region's clean technology companies more successful, accelerate the growth of the region's clean technology economy, and sustain and grow a world-class clean technology cluster. The RTCC's work plan focuses on building global networks for research and business development, supporting and connecting the region's burgeoning entrepreneurship community, talent attraction and targeted workforce development, and facilitating industry-led discussion of effective public policies. The RTCC works closely with partners around the world - including Singapore and regions in France, Germany, Austria, Denmark, Italy and Spain - to showcase the Research Triangle Region's cleantech assets and facilitate connections between our local experts and cluster contacts worldwide¹¹."

- FREEDM and The Advanced Transportation Energy Center (ATEC)
ATEC is part of the Freedom Systems Center on North Carolina State University's (NCSU) Centennial Campus. ATEC's mission is to "develop fundamental and enabling technologies that will facilitate the electric power industry to actively manage and control large amount of plug-in hybrid vehicle (PHEV) and PEV. ATEC will also develop battery and power electronics technologies to help the automobile industry develop better and more efficient PHEVs and PEVs, hence allowing our nation to move away from gasoline based vehicles. ATEC will also educate the public about the advantages of PHEV and PEV through its outreach program in collaboration with industry sponsors¹²."

Other notable programs and initiatives in North Carolina include:

- *Sustainable Transportation Education Program (STEP)*- more information housed in the Education and Outreach section
- *North Carolina Center for Automotive Research (NCCAR)*- more information housed in the Vehicles section
- *EV Challenge*- more information included in Education and Outreach section

A detailed overview of existing initiatives is outlined in each section of the NC PEV Roadmap.

Goals of the North Carolina PEV Roadmap

The NC PEV Roadmap will not be adopted by a decision making authority and will not be implemented by any one agency; instead, this plan is intended to serve as a guide for stakeholders to implement applicable sections of the plan. This approach is reflected in the goals outlined below:

- Goal 1: Prepare NC for PEV adoption through active stakeholder engagement
- Goal 2: Enable NC to become a leader in electric transportation
- Goal 3: Foster the acceleration of PEV adoption through a structured approach to readiness activities
- Goal 4: Align the benefits of PEVs with other initiatives in NC to maximize effectiveness. Examples include economic development, clean air and water initiatives, and petroleum reduction initiatives

NC PEV TASKFORCE
STAKEHOLDERS AND TASKFORCE MEETINGS
AND COMMUNITY READINESS PLANS



2

STAKEHOLDER ENGAGEMENT: STATE AND COMMUNITY PLANNING

The NC PEV Taskforce is a collaborative stakeholder organization committed to advancing PEV initiatives in North Carolina.

NC PEV Taskforce

The NC PEV Taskforce was formed in the Spring of 2011 by the North Carolina Department of Commerce and Advanced Energy. Advanced Energy serves as the co-chair of the Taskforce along with NC Department of Commerce. Steering Committee members organized the kick off symposium for the taskforce by the fall of 2011.

Steering Committee

The Steering Committee is comprised of stakeholders who have actively been engaged in PEV initiatives in North Carolina including the electric utilities, state, local and regional government entities, PEV industries, non-profits, academia, employers, businesses and research entities. Members of the Steering Committee volunteered to lead the working groups for the Taskforce.

The roles of the Steering Committee included monthly collaboration between working group leads and planning quarterly taskforce meetings.

Taskforce Members

The Taskforce is a collaborative partnership of stakeholders in North Carolina. Examples of Taskforce members included:

- State, Regional and Local Government (staff and elected officials)
- PEV Industries
- Civic Organizations
- Business and Employers
- Universities, Colleges, and Community Colleges
- Nonprofit Organizations
- Electric Utilities

Working Groups

The NC PEV Taskforce consisted of five working groups led by NC PEV Taskforce Members:

Working Group	Working Group Lead
Vehicles	Triangle J Council of Governments (TJCOG)
Infrastructure	Progress Energy Carolinas and Duke Energy Carolinas
Education and Outreach	Advanced Energy
Policies, Codes and Standards	Centralina Council of Governments (CCOG)
Incentives and Economic Development	NC Solar Center/NC State University and the North Carolina Department of Commerce

Working Groups were formed based on attendance and survey responses from the October 2011 Symposium and grew based on outreach and education.

NC PEV TASKFORCE MEETINGS

The NC PEV Taskforce held four meetings during the PEV readiness planning process, three in-person and one teleconference. Taskforce meetings marked the first collaborative opportunity to gather participants in the state to discuss PEV related topics.

October 2011: Symposium

The first Taskforce meeting was held in October 2011. This meeting marked the first state-wide gathering of participants to discuss PEV related topics. Symposium attendees participated in facilitated discussions on barriers and opportunities surrounding PEVs in the state.



Figure 3 Taskforce Symposium

Event Item	Activity
Date	October 27, 2012
Location	Raleigh, NC, McKimmon Center, NCSU
Number of Attendees	100
Theme	<ul style="list-style-type: none"> • First Taskforce Meeting • Engage Stakeholders • Identification of Barriers and Opportunities for PEV in NC
Agenda	<ul style="list-style-type: none"> • Introduction to Taskforce • Introduction to Working Groups • PEV 101 • Breakout Sessions- facilitated discussion on issues surrounding working groups
Takeaways	<ul style="list-style-type: none"> • First gathering of stakeholders in NC around the topic of PEVs • Participants formed base for five working groups • Working Group leads received a comprehensive list of barriers and opportunities to explore over the following year

March 2012: Webinar

The second Taskforce meeting was held in March via a live broadcast teleconference, where participants were able to engage with members by attending the meeting via one of four locations in the participating communities for the M2S project including Asheville, Charlotte, Piedmont Triad and the Triangle.

Event Item	Activity
Date	March 20, 2012
Location	Live Broadcast Locations: Asheville, Charlotte, Winston-Salem, Research Triangle Park
Number of Attendees	95
Theme	Cross Community Collaboration (between community PEV readiness planning efforts)
Agenda	<ul style="list-style-type: none">• PEV Planning in the Greater Seattle Region: Presentation from the Puget Sound Regional Council• Working Group Updates (working groups presented on their progress)• Community PEV Readiness Planning Updates• Cross Community Collaboration
Takeaways	<ul style="list-style-type: none">• First Report for Working Groups• Opportunity for Communities in M2S project to receive state-wide update and to share information

June 2012: Piedmont Triad

In June, the Taskforce held an in-person meeting which marked the first in-person meeting since the kick off symposium in October 2011. The Steering Committee chose to host the second meeting in the Piedmont Triad for the following reasons:

- Central location in the state, located approximately 1.5 hours from Triangle, Charlotte and the Asheville Communities
- The Piedmont Triad was in the beginning stages of PEV readiness preparations and the Taskforce meeting served to leverage the efforts and bring together local in stakeholders.

PEV readiness preparations and the Taskforce meeting served to leverage the efforts and bring together local in stakeholders.



Figure 4 June NC PEV Taskforce Meeting

Event Item	Activity
Date	June 19, 2012
Location	Kernersville, NC (located between Greensboro and Winston-Salem in the Piedmont Triad Community)
Number of Attendees	89
Theme	<ul style="list-style-type: none">• Elevate PEV Awareness in the Piedmont Triad• Half-way Point for M2S Project• Update from PEV Manufacturers
Agenda	<ul style="list-style-type: none">• Welcome from Local Mayors• Update from Nissan North America• Panel Session with Working Groups (incorporating live audience polling)• Panel Session with Community Readiness Plan Leads
Takeaways	Received real-time feedback from meeting participants from panel sessions

September 2012: Charlotte

The September NC PEV Taskforce meeting was originally scheduled to be a live webinar, however the meeting was able to be held at the Charlotte Convention Center through a partnership with the 2012 High-Efficiency Truck Users Forum (HTUF) organized by Calstart. The September Taskforce meeting marked the one year anniversary of the Taskforce and was the last meeting before the NC PEV Roadmap and four community readiness plans were released.

Event Item	Activity
Date	September 19, 2012
Location	Charlotte, NC
Number of Attendees	82
Theme	<ul style="list-style-type: none"> • One year anniversary of the Taskforce (first meeting held October 2011) • Last meeting before the State PEV Roadmap and the four Community Readiness Plans are released • Focus on Infrastructure
Agenda	<ul style="list-style-type: none"> • Welcome from Local Mayors • Trends in Electric Vehicle Charging Presentation by NEMA • Electric Vehicles in Stock Car Racing – Petty Enterprises • Working Group Panel Session (live audience polling) • Charging Station Installations: Experiences and Lessons Learned • Community PEV Planning: Break Out Sessions
Takeaways	Received feedback on final recommendations for state readiness plan (via live polling devices)

Barriers and Opportunities Identified for the Statewide Readiness Plan

In planning for PEV implementation, both barriers and opportunities must be addressed. North Carolina is not unique in that there are significant barriers and untapped opportunities. Taskforce members have helped to identify and address barriers and opportunities during the planning process for the M2S project.

The NC PEV Roadmap is centered around five key elements, and each element had a designated working group where members began to address barriers through the PEV planning process. Taskforce members participated in a facilitated exchange, at the first taskforce meeting, where they identified key barriers and opportunities for PEV implementation. These results were compiled and supplied to working group leads to address during the planning process.

For the NC PEV Roadmap, these initial discussion points were revisited and evaluated to review progress made and can be found in Appendix 3.

Key Barriers and Opportunities

North Carolina’s biggest barriers as perceived by the taskforce members, centered on a need for standards, knowledge and policies. Although all barriers have not been addressed, most have been explored by working groups and recommendations are included in the Policies, Codes and Standards section of this roadmap. Education and outreach stands out as a topic area that overlaps many of the other topic areas. For example, education and outreach is a key component of accelerating the purchase of PEVs (a topic discussed in the Vehicles Working Group).

Coordination with Other Statewide Plans

While the NC PEV Roadmap marks the first statewide plan for PEV readiness, other plans in the state have recommendations calling for the promotion of electric vehicles. Coordination between plans will ultimately yield the greatest success for the NC PEV Roadmap. The list below contains a few examples of plans or planning efforts that identify electric vehicle integration as a method to help achieve one or more of their goals:

- **Healthy North Carolina 2020: A Better State of Health**
NC Department of Health and Human Services: <http://publichealth.nc.gov/hnc2020/>
Goal- encourage policies to promote electric vehicles because of the environmental health benefits
- **North Carolina Department of Transportation 2040 Plan**
<http://www.ncdot.gov/performance/reform/2040Plan>
This plan identifies the adoption of electric transportation as a way for NC to become a leader through embracing green technology while achieving environmental and quality of life benefits.
- **Southeast Diesel Collaborative**
Part of the Environmental Protection Agency's National Clean Diesel Campaign
Has three focus areas: Public Fleet, Freight, and Non-road¹³
- **NC Tomorrow**
A collaborative partnership including the NC Regional Council of Governments, the NC Department of Commerce, U.S. Department of Housing and Urban Development and SAS Institute. These stakeholders are working to develop a NC Strategy for Comprehensive Economic Development. The economic development impacts from PEV technology is already being realized in North Carolina due to the efforts of the NC Department of Commerce's leadership in the NC PEV Taskforce¹⁴.
- **State Fleet Petroleum Displacement Plan**
The Session Law 2005-276 State Budget Appropriations mandates that state agencies, universities and community colleges with state-owned vehicle fleets achieve a 20 percent reduction or displacement of petroleum products¹⁵.
- **NC Department of Environment and Natural Resources**
(Division of Air Quality and Division of Water Quality)
Increased integration of electric vehicles can help to improve air quality and water quality in the state.

Coordination between State Roadmap and Community Readiness Plans

Community PEV Readiness Plans: Asheville, Charlotte, Piedmont Triad, Triangle

This plan is intended to serve as a state-wide plan, documenting coordinated efforts of the community readiness plans created through the NC PEV Readiness Initiative: Plugging-in from Mountains to Sea. Community Readiness plans were created in the Asheville, Charlotte, Piedmont Triad and Triangle areas of NC. In each case, the local readiness plans were led by the local Council of Governments (COG).

The intention of the readiness process was for the stakeholders to share information between the state-wide readiness plans and local readiness plans.

Community Readiness Assessments

At the beginning of the community planning process, a community readiness assessment was completed for each partnering region as part of the M2S project. Partners returned to review the assessment upon the completion of the plan to track the progress made. In all cases, the communities increased their score for readiness.

The Asheville, Charlotte, Piedmont Triad and Triangle all completed the community assessment process by assigning a “readiness score” to each element of the U.S. DOE’s suggested topics for readiness planning.

Scores were applied to a total of 11 planning elements and were assigned the following criteria:

- 0 = Not Started
- 1 = Activities Begun
- 2 = Significant Progress
- 3 = Completed

Partners each reviewed and completed the assessment table once the process was complete and found that in all cases the score was increased. Table 1 provides these results.

Table 1. Community Readiness Assessment Scores							
Triangle		Charlotte		Asheville		Piedmont Triad	
Initial Score	Final Score	Initial Score	Final Score	Initial Score	Final Score	Initial Score	Final Score
18.0	24.0	18.0	24.0	16.0	22.0	0.5	15

The Community Readiness Assessment Table is included in Appendix 1.

Key Findings of Community PEV Readiness Plans

Each community had key findings that differentiated their community from the others. Table 2 provides some of the key and distinct findings.

Table 2. Key Findings	
Community	Finding
Greater Asheville Area	Tourism The greater Asheville area is one of the top tourist destinations in North Carolina, attracting people throughout the year. The Asheville PEV Readiness Plan explored ways they could integrate electric vehicles into their tourism economy.
Greater Charlotte Area	Local Business Involvement Charlotte's growth over the last few decades is due in large part to the strength of its business community. The Charlotte PEV Readiness Plan looked at ways to harness existing involvement of the business community with PEVs to continue accelerating the growth.
Piedmont Triad	Building Consensus with Engaged Stakeholders The Piedmont Triad, which includes the Cities of Winston-Salem, High Point and Greensboro undertook a more foundational approach to PEV readiness due to not having an official organized effort in place before the M2S project started. They found that their stakeholders are eager to become engaged in PEV readiness planning and will continue involvement moving forward.
Greater Triangle Area	State-wide Focus The Greater Triangle is located in the state capital causing many of the stakeholders to have a state-wide focus. Leaders in the Triangle PEV readiness efforts found they can apply the resources developed locally in the Triangle to entities across the state.

Conclusion

The focus of the NC PEV Roadmap and the four community readiness plans in the Asheville, Charlotte, Piedmont Triad, and Triangle was stakeholder engagement. The Roadmap harnessed the existing collaborative efforts of the NC PEV Taskforce to serve as a structure for development of the plan. Parallel efforts of the state and community readiness plans allowed for a unique opportunity to share information during the planning process which helped to shape the outcome of both the roadmap and the community readiness plans.

Stakeholder involvement will be a key factor in moving forward to build on the recommendations and findings from the state roadmap and community readiness plans. The NC PEV Taskforce will assist with building awareness through continued efforts in 2013.

VEHICLES



3

Authored by:
NC PEV Taskforce Vehicles Working Group

Led by:
Triangle J Council of Governments/Triangle Clean Cities Coalition

INTRODUCTION TO PEVS

PEVs have continued to gain in popularity in the U.S. and in North Carolina and numerous models, many by vehicle manufacturers, have come to the market or will in the near future. Therefore, it has become increasingly challenging for buyers to be knowledgeable about all the available vehicle technologies and options.

The Vehicles Work Area of this readiness plan covers goals related to tracking the number and types of PEVs in operation in the North Carolina and making information available about PEVs to both governmental planners and potential PEV drivers. The information contained in this topic area helps to define the context for other topic areas of this plan as it shows the current extent of PEV deployment as well as future projections. Stakeholders involved in this part of the planning gave feedback about the suitability and cost-benefit comparison of PEV use versus the use of conventional internal combustion engine (ICE) or hybrid vehicles. They also helped develop strategies to keep local fleets and other stakeholders informed and interested in PEV adoption.

North Carolina's Existing Initiatives

North Carolina is a leader in electric vehicle planning and implementation with Raleigh listed among the best prepared cities in the U.S. according to a recent report by Roland Berger strategy consultants and RMI¹⁷. North Carolina is a key market for the rollout of PEVs in part because of its long history with this technology. While in 1890, PEVs outsold gasoline cars 10 to 1 nationwide¹⁸, many point to the modern electric car era beginning in 1990 with California's Zero Emission Vehicle (ZEV) Mandate¹⁹ and GM's response in producing the EV1. The EV1 was mostly leased in California in response to the mandate, but they made their way out to drivers in North Carolina as well.

'15-'15' READINESS VS. FUTURE MOMENTUM OF TOP 50 METROS

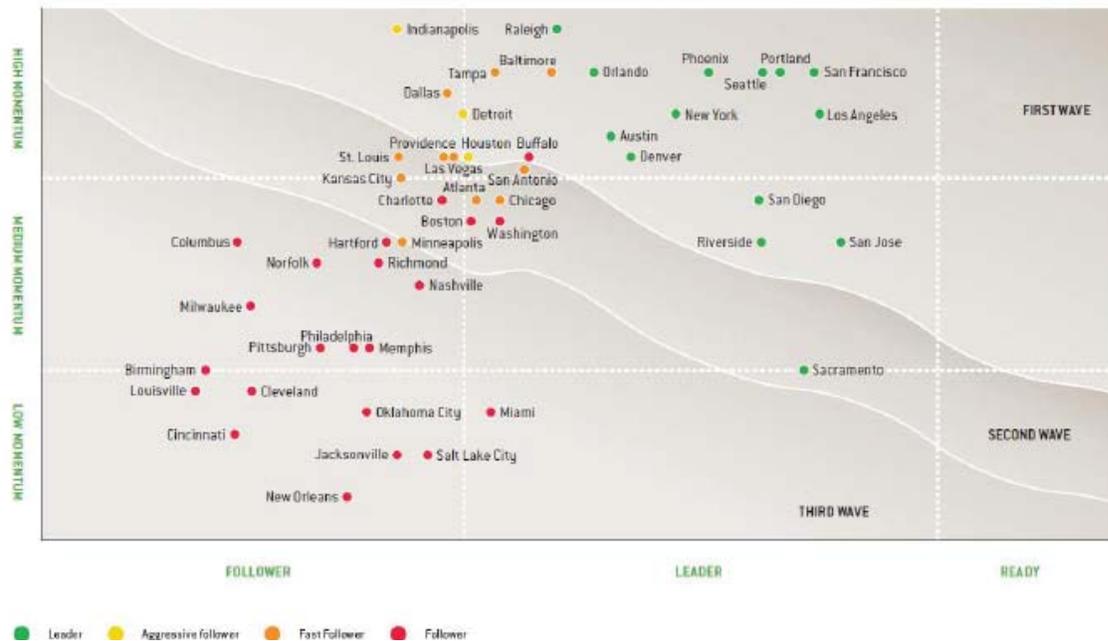


Figure 5 EV Readiness Rankings from Roland Berger consultants, 2010

Mass produced PEVs were not the only option open to industrious North Carolinians seeking to adopt this technology. In the late 1980s, NC PEV Readiness Plan partner Advanced Energy began their research with PEVs by converting a Pontiac Fiero and Chevrolet Van to battery operated vehicles, and then continued to grow into this area of research with the Plug-In Hybrid Electric School Bus Project in 2001. By 2009 the Triangle Electric Auto Association had signed its bylaws²⁰ to become a chapter of the national EV enthusiast group called the Electric Auto Association (EAA). Two other NC chapters of the EAA, Triad Electric Vehicle Association & Coastal Carolinas Wilmington, provide evidence of excitement about electric vehicles throughout the state²¹.

With our history of enthusiasm for PEVs and our current leadership in adopting the technology, it was fitting that on March 7, 2012 at the Daimler Truck factory in Mt. Holly, NC, President Obama launched 'EV-Everywhere,' the second grand challenge of the U.S. DOE. This competition encourages American scientists, engineers, and businesses to work together to "produce a five-passenger affordable American electric vehicle with a payback time of less than five years and sufficient range and fast-charging ability to enable average Americans everywhere to meet their daily transportation needs more conveniently and at lower cost²²." North Carolina's participation in programs like EV-Everywhere and in developing the comprehensive M2S PEV Readiness Plan will maintain its leadership in this sustainable technology.

Market Introduction

As of December 2012 the PEVs available for purchase and in use in NC include:

- Chevrolet Volt
- Nissan LEAF
- Mitsubishi i-Miev
- Ford Focus EV
- Several other small-production models by Tesla, Fisker, Coda and Think

The limited initial availability of the Focus Electric in NC did not stop one man from Charlotte, NC who purchased a Focus Electric from a dealership in New York and may have become the first retail customer to receive their car in the US on May 26, 2012²⁵.

Ford has also released a PEV with the all-electric version of the Focus. Despite initial announcements in November 2011 that Raleigh-Durham, NC would be among the first markets for a rollout in late 2011²³, this vehicle has only been distributed to dealerships in California, New Jersey and New York with plans to add another 13 states to that list in 2012²⁴.

Several other models are expected to be deployed soon, including:

- **Prius (PHEV)**
Launched in 15 states in March of 2012; should be in all 50 states in 2013²⁶
- **Ford C-Max Energi (PHEV)**
Should begin "arriving Fall 2012 in 19 U.S. markets, followed by a nationwide launch in all 50 states in early 2013²⁷"

For a full and up-to-date accounting of what new vehicles are coming out and when, visit the "Plug-in Vehicle Tracker" at <http://www.pluginamerica.org/vehicles>

Auto Manufacturer Input

Several of the major auto manufacturers responded to requests to engage with the NC PEV Taskforce and the Vehicles Working Group. Through this planning process they sent representatives to meetings to outline the current deployment status of their vehicles, described their collaborations with utilities and other related industries, and provided their perspectives on the beginnings of the modern PEV market in NC and nationwide. This open exchange of information from several auto manufacturers helped to provide a reliable context for the markets and the technologies that are being developed during this planning process.

Dealerships, Rental Agencies and Rideshares

Dealerships obviously play an integral role in increasing the availability of PEVs in the state. A long list of dealerships have participated in the planning process and have supported educational events such as ride-and-drives and training for first responders as well as offering valuable insights into the current barriers and solutions to PEV adoption.

Beyond buying or leasing a PEV there are several other routes available to North Carolinians for trying out a PEV. Car rental agencies such as Enterprise Holdings are currently investing in PEVs and charging stations. Focusing initially in California, Enterprise has plans to place the Nissan LEAF into all markets where Nissan will support it²⁹. Through their WeCar car-sharing program, Enterprise has already made four Chevy Volts part of their normal fleet available to students at Duke University in Durham, NC who participate in the program³⁰.

Public Technical and Financial Support

The U.S. DOE promotes alternatives to petroleum usage in vehicles through the Clean Cities program. There are currently nearly 100 Clean Cities Coalitions in the country³¹ and three that work in North Carolina are among the primary contributors to this plan. Through forming a central point for technical assistance and collaboration on grants, these Coalitions bring together stakeholders from the public and private sectors and have displaced millions of gallons of petroleum that would otherwise have been burned in this state. All of these programs are housed in NC COG, each of which are dedicated to supporting the local governments in their multi-county regions through planning, technical, and financial assistance through grant administration³². Several of these Councils of Government have been engaged throughout this planning process and have given their support to this plan.

Working on a statewide level, the NC State Energy Office and the NC Solar Center have also helped stakeholders through creating or coordinating vehicle purchase grants, and other programs and projects designed to increase the use of alternative fueled vehicles such as PEVs. There are also several research organizations in North Carolina that are dedicated to improving the knowledge and technologies that PEVs and their infrastructure depend upon. Two of these are the Advanced Transportation Energy Center (ATEC) which is focused on developing vehicle battery and power electronics technologies³³, and Advanced Energy's Electric Transportation program which is committed to helping people "understand, plan for and implement electrified transportation." Advanced Energy has led this arena with several ground-breaking initiatives like the Plug-in Hybrid School Bus Project and the PEV Usage Study³⁴ and they are a co-author of this plan.

NC PEV Taskforce: Vehicles Working Group

Goals and Objectives

During the first working group meeting, the group identified several possible goals, and many of the initial ideas for this topic area overlapped with those of other NC PEV Workgroups. Finding effective ways to promote vehicles, for instance, would fall under the Outreach Workgroup and figuring out which incentives work for first-time adopters would fall under Incentives. While it was possible for the Vehicles Working Group to merge or partner with these groups to pursue these aims, it was decided it would remain an independent group while pursuing the following more fundamental goals and then join in with other workgroups if time allowed.

Goal 1: Reduce the barriers to PEV adoption in NC that pertain to the vehicles themselves.

Objective: Compile a list of barriers and discuss with local and national experts.

Goal 2: Increase the available information about PEVs in the state, both now and on an ongoing basis, as a foundation for other PEV planning efforts.

Objective: Establish communications with the North Carolina Department of Motor Vehicles (NCDMV) and determine what information is available.

Goal 3: Predict the future of PEV deployment in NC in terms of the number, type, and uses of PEVs.

Objective: Establish contacts with Original Equipment Manufacturers (OEMs) and other experts request deployment information or other estimates.

Working Group Members

Most members of the NC PEV Taskforce volunteered to be a part of the Vehicles Working Group at the launch meeting on October 27, 2011. Several others joined the working group over the course of the successive months of plan input. The final member list is included in the beginning of this document.

Members of this working group included representatives from private vehicle, equipment, and technology firms as well as public educational, governmental and planning organizations from across the state.

Focus Areas

This workgroup decided to align its focus areas with those of the U.S. DOE sample plan, and then to add in other focus areas as needed to tailor the plan to the state.

- Assess and propose reductions to barriers to PEV adoption in NC that pertain to the vehicles themselves, such as vehicle availability, battery life, vehicle range, vehicle performance and total cost of ownership.
- Establish regular communications with the NCDMV to collect information on the number, type, and location of registered PEVs in the state, both now and on an ongoing basis.
- Collect information from the Original Equipment Manufacturers (OEMs) on their plans for further PEV deployment in NC
- Assess current usage of PEVs in public and private fleets in NC and estimate future usage.
- Collect information on the usage patterns of current PEV users.

PEV Planning

In order to address focus area number one and begin to identify and resolve the barriers to PEV adoption in North Carolina, the group invited several experts to come and speak.

Expert Input

The first expert to speak to our group was in March from the Electric Power Research Institute (EPRI), and they brought us quickly up to speed on what their general PEV research has shown and specifically on their total cost of ownership. EPRI is currently updating an in-depth analysis they conducted in 2011 of the total costs to a vehicle owner of a PEV versus a similar internal combustion engine vehicle. Their analyses focused on a suite of currently-available vehicles including the Chevrolet Cruze, Nissan LEAF, Chevrolet Volt, Mitsubishi iMiEV, Plug-in Prius, Lexus 250h Sedan, Honda Civic CNG, and the Honda Fit. Initial results found a surprisingly low payback period for the LEAF of only two-to-six years, when factoring in ticket price, tax credits and operations and maintenance costs which included the reduction in fuel costs. The 10-year total cost of ownership for the Chevrolet Volt is also competitive with other models across other fuel types and drivetrains (see Figure 6).

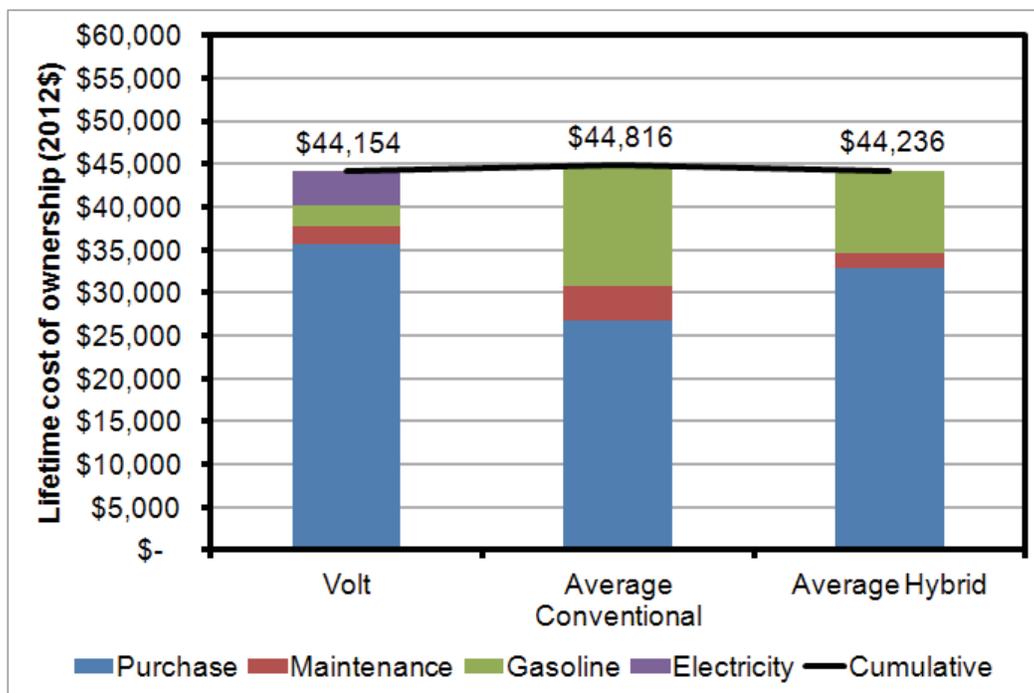


Figure 6 Chart created by Electric Power Research Institute

Auto manufacturers Ford, GM, and Nissan also responded to requests to engage with the NC PEV Taskforce and the Vehicles Working Group. In April, a representative from General Motors spoke to the Vehicles Working Group to outline the current deployment status of the Chevy Volt and new models that are on the way. They also explained their collaboration that began in 2007 with the EPRI and over 50 utilities nationwide to better understand and address technical issues such as Vehicle-to-Grid interfaces, as well as to align messaging and policy priorities and develop business opportunities. This is the largest existing collaborative effort of its kind. This alignment of priorities and perspectives across electricity producers, researchers and users seems to be an excellent model to assist the advancement of PEVs nationally, and in many ways it is being emulated locally by the NC PEV Taskforce. Other insights offered by GM include their perspective that current DC fast charging technologies, even if implemented on a massive scale along highways, will still not enable convenient long-distance BEV driving. In their expert opinion, BEV users are unlikely to want to stop several times to recharge on a long trip, even if only for 20-30 minutes at a time.

In their June meeting, the Vehicles Workgroup heard presentations from both Ford & Nissan. In advance of Nissan's presentation to the quarterly general meeting of the NC PEV Taskforce, Nissan talked to the workgroup about their experiences with the LEAF and their new models being developed. They also discussed some legal and logistical challenges associated with lease options for municipal fleets such as the ways that multi-year leases and municipal fiscal years don't align. There are opportunities as well such as volume discounts and reduction of risk if technology changes faster than the life of the vehicle. Ford discussed their general rollout plan for the Focus Electric, and similar to GM, their focus on partnerships for research and development of business and policy options. Ford partnered with Best Buy to provide an at-home charging installation service and with Microsoft to help PEV owners reduce electricity charges by charging at off-peak hours through their Value Charging system. Sensing a shared business interest and target audience, Ford has even partnered with Sunpower, a company that installs rooftop solar systems. Sunpower works with interested Ford PEV owners to install solar systems that can help to offset the electricity used by a PEV. One of the areas Ford and Nissan differed was in their support of different standards for DC fast-charging plugs. Nissan supports the existing CHADEMO solution developed in Japan, while Ford and other North American and European automakers support the new SAE J1772™ combo connector DC fast charging standard. Currently the two solutions are not compatible.

Estimate of Personal PEV Deployment

While collecting and considering expert input, the task that the workgroup identified to cover first was to work with the NCDMV to pull data on the number of registered PEVs in the state. Once the data on the current number of PEVs in the state was collected, it would form a useful baseline for several other areas of the plan. While straightforward on its surface, this process was complicated by several factors including the number and size of transportation administration and planning organizations in North Carolina, as well as the necessary privacy protections associated with vehicle registration information.

The first data the workgroup received was from the NCDOT. Because it was based on a query that pulled all of the registered vehicles coded with an "electric" fuel type, it included what appeared to be small low-speed neighborhood electric vehicles (NEVs) and golf carts, as well as vehicles known to be gasoline-powered. Since the vehicle registrations and title applications data that form the basis for this data can be entered by NCDMV employees at more than 100 Vehicle and License Plate Renewal Offices throughout the state, as well as by any automobile dealer through an on-line form³⁵, it is not surprising there was some variability in the way vehicles were classified by fuel type. The work group did not think it was an accurate representation of the current numbers of PEVs in the state and began looking for another source. A second dataset from the NCDMV provided the workgroup with a much more filtered set of results, yet this report was unofficial and limited to only a few counties.

Finally, with the help of Advanced Energy, the workgroup found that the Data Control Unit of the Traffic Records Branch of the NCDMV is the entity responsible for determining eligibility and responding to requests for information on registered vehicles. Eligible entities are defined by general statute. Once the workgroup contacted the Data Control Unit³⁶, the process for proving eligibility and requesting the registered vehicles data was clearly and professionally explained and managed.

Through this office, Advanced Energy paid for data on the Chevy Volts and Nissan LEAFs for five of the Triangle counties as a preliminary test of the system. The data that came back was well-organized and seemed to be consistent with other preliminary estimates.

Through this channel, workgroup leads at the Triangle J Council of Governments were approved to receive a free government-to-government download of all of the PEV models that were then available in the state (July, 2012) on the address level. Our previous experiences as well as discussions with workgroup members allowed us to craft a specific data request aimed at providing the most complete and accurate representation of PEVs in the state that was possible, given that there was no specific code for high-speed plug-in vehicles. Due to a backlog of requests, the data took 5 weeks to arrive. As of mid-August 2012 there were 719 registered PEVs in North Carolina. 646 of these were privately owned or leased.

The Chevy Volt and the Nissan LEAF are the predominant PEV models in use in NC, followed by a variety of smaller production vehicles from Fisker Automotive, Mitsubishi, Tesla, and Think. Most of the PEVs in the state are concentrated in the Triangle region, followed by the Centralina region around Charlotte. This trend follows population and urbanization concentrations, although there is also a significant number of PEVs in other counties, some being predominantly rural areas.

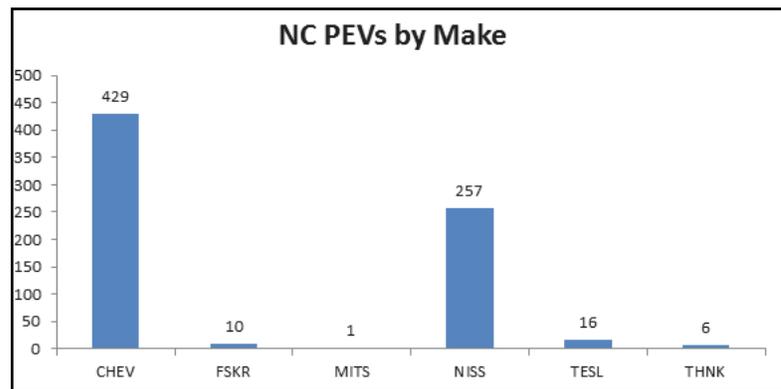


Figure 7 NC PEVs by make

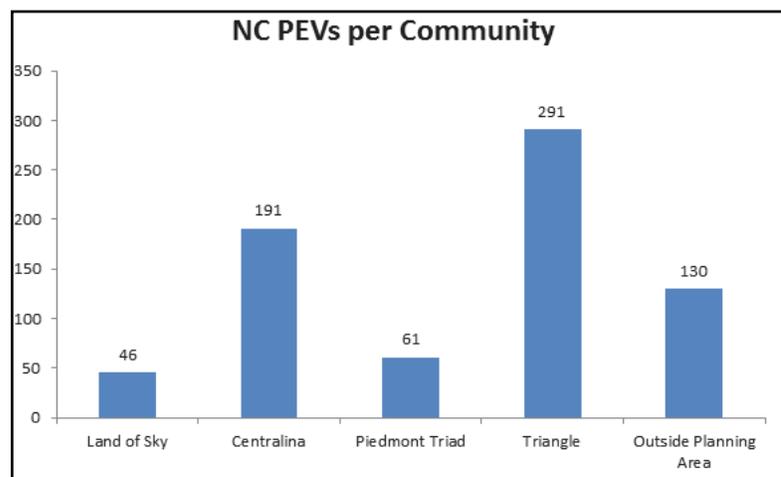


Figure 8 NC PEVs per community

As might be expected, PHEVs which can use either gasoline or electricity have spread farther throughout the rural areas of the state where there is less public charging infrastructure. With that in mind it is interesting to note that there is still a significant presence of BEVs in rural areas in the eastern and western portions of the state. This may underscore the patterns that most PEV users do most of their charging at home.

In the future, the NC PEV Taskforce will be able to model future data update requests on this initial effort with an updated list of the makes and models of PEVs available in the state at that time. Other states are employing different data request methods such as re-requesting and sorting the list entire the vehicle identification numbers (VINs) for all registered vehicles in the state. This would likely produce slightly different results, and may reduce some of the variability and errors associated with self-reported information. This system would also be much more time and technology-intensive and the need for increases in accuracy would need to be weighed against that increased investment.

Projected Estimate of Personal PEV Deployment
 EPRI has modeled the growth of the PEV market at the county level in the U.S. over the next 20 years. This model has a high degree of error (of somewhere around a factor of ten), but it can be used as a starting point for discussions about what we can expect future PEV deployment to look like.

Analysts seem to agree that the PEV market in the state will grow slowly over the next few years, but it is expected to pick up dramatically. Uncertainty in the degree of this increase grows when factoring in the possible impacts of increases in the costs per gallon of petroleum, but the increase itself is not often questioned given historical patterns³⁷.

The current distribution pattern of PEVs in NC is expected to remain largely the same over the next 10-25 years, with the greatest gains felt in metropolitan regions and those along the Interstate 40 and Interstate 95 corridors. Please note the increasing numbers of PEVs denoted by the colors in the maps above.

Registered Plug-in Electric Vehicles in North Carolina by County (August 2012)

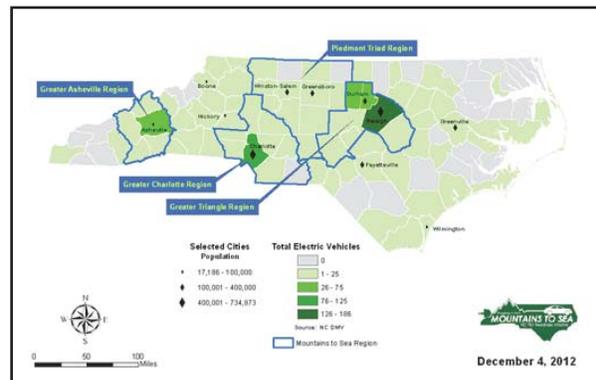


Figure 9

Registered Battery Electric Vehicles in North Carolina by County (August 2012)

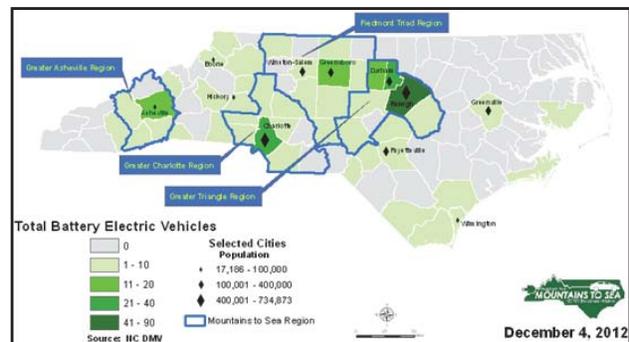


Figure 10

Registered Plug-In Hybrid Electric Vehicles in North Carolina by County (August 2012)

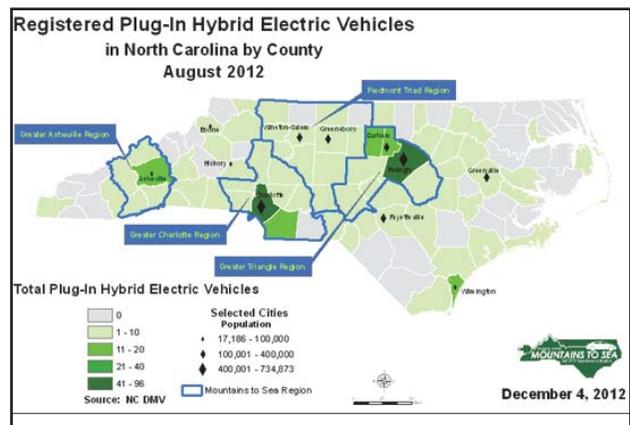


Figure 11

Projected Number of Registered Plug-in Electric Vehicles in North Carolina by County: 2020

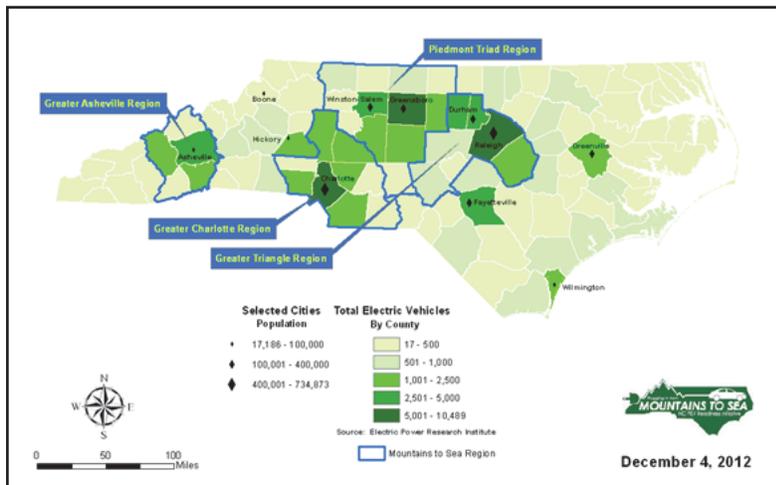


Figure 12

Projected Number of Registered Plug-in Electric Vehicles in North Carolina by County: 2030

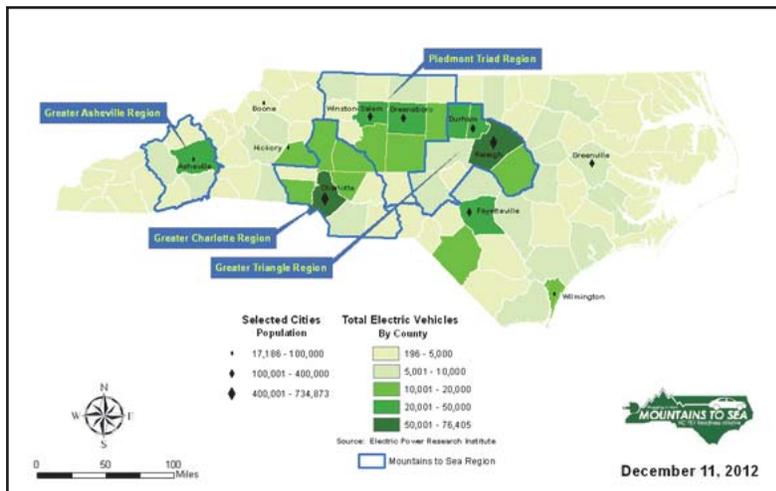


Figure 13

By 2020, EPRI estimates that there will be over 94,000 total PEVs in North Carolina, and this number increases to over 768,000 by 2030. Assuming that the percentage of PEVs owned by individuals instead of fleets will remain constant at 90 percent, the estimate of personal use PEVs in 2020 is expected to be over 84,000 and in 2030 over 691,000.

Validation of EPRI's model can be achieved only within its large given error range. That said, the model predicts that there will be 848 PEVs in North Carolina by the end of 2012, which is relatively close to what is expected given there were 719 PEVs as of August 2012, which left the entire last quarter of 2012 for further growth.

Estimates of Current and Future Fleet Deployment

The same NCDMV data that we relied on to estimate the number of personally-owned PEVs can be used to estimate the number of PEVs that are owned by fleets. NCDMV records show that as of mid-August 2012, 50 of the 719 registered PEVs in North Carolina (seven percent) were fleet vehicles. Similarly, the same EPRI model and modifying calculations used to find the projections for personally-owned vehicles in the future can be applied to fleet estimates with the same level of confidence.

By 2020, EPRI estimates that there will be over 94,000 total PEVs in North Carolina, and this number increases to over 768,000 by 2030. Assuming that the percentage of PEVs owned by fleets will remain constant at 10 percent, the estimate of personal use PEVs in 2020 is expected to be more than 9,000 and more than 76,000 in 2030.

Fleet adoption of PEVs may be expected to grow faster if the business case can be made to them. If EPRI's total cost of ownership study is correct and PEVs can have a two-to-six year payback period, then they can be expected to save a fleet a significant portion of their operations maintenance costs over a 10 year duty cycle. With their economies of scale, fleets may find it easier than individuals to overcome the higher initial purchase price for PEVs in order to take advantage of overall savings. Some of the largest commercial fleets such as Frito Lay and FedEx are already using PEVs for medium-duty delivery trucks. With 275 and 87 all-electric trucks deployed respectively in the U.S. by the end of 2012³⁸, these two companies are helping to make that business case for all commercial fleets. In one dramatic and recent example from the public sector, the Pentagon has announced plans to purchase 1,500 Chevrolet Volts³⁹ over the next few years.

Responses to a survey of fleet managers in North Carolina conducted by the NC Solar Center show that NC fleets may have begun to see this business case already. Out of 242 respondents, close to 40 percent said that they either had a high level of interest in purchasing PEVs or that they already had purchased them. Only 12 percent had no interest⁴⁰.

Projected Usage Patterns of PEVs

North Carolina will learn about usage patterns of PEVs through PEV Consumer Usage Study conducted by Advanced Energy. This multi-year study launched in 2011 intends to leverage both of the DOE/Blue Skies and North Carolina State Energy Office consumer adoption initiatives. The study will build upon the strong momentum created through the implementation of these initiatives, which helped deploy public and workplace charging infrastructure across North Carolina and incentivized the purchase of 40 PEVs. The vehicle usage data obtained through this program will help determine how typical drivers use PEVs and evaluate any changes in operating behaviors over time. This study will quantify how, when and where PEVs are used and how they impact the electrical grid. Results from the study will support planning activities related to charging, usage clustering, and electrical load characteristics. This study will also provide information that will highlight changes in 'range confidence' as consumers become more familiar with their vehicles and the availability of charging infrastructure within their usage corridors.

Owner Type Classifications of Registered PEVs:

The determination of Owner Type was completed through sorting the NC PEV registration information by owner names and addresses and then applying the following assumptions:

- When an individual's name was used for one vehicle, this was considered a privately owned vehicle. (No individual had more than 2 vehicles registered to their name.)
- When a company name was included, it was written into the last name field. These were all considered private fleet vehicles unless:
 - The company was a dealership in which case the record was classified as a lease vehicle.
 - The company was a rental car company, in which case the record was classified as a rental fleet vehicle.
- Business names and addresses were used to verify the business type online in cases of uncertainty.
- When a government or government agency was included, it was also written into the last name field. These records were all classified as public fleet vehicles.
- When the vehicles were owned by a financing institution, or there was no name listed in the record, these vehicles were listed as an "unknown" owner type.

As of November, 2012 the study has collected 10 months of data and produced over 300,000 electric miles driven, two billion data points and displaced over 10,000 gallons of gasoline. Preliminary results find that over 67 percent of participants are charging both at work and at home. Additionally the maximum daily miles traveled has increased as users become more comfortable with the range of their vehicles. The study has also found that there are distinguishable differences in charging patterns between those with and without home charging stations. Additional data will be released as the study continues. For more information on the PEV Consumer Usage Study visit www.AdvancedEnergy.org/transportation/programs_and_initiatives.

According to data collected by the Idaho National Labs collected through the EV Project, the average distance a BEV owner travels per day is 30.8 miles, which is within the range of the average daily commute in North Carolina.

EREVs such as the Chevy Volt can be expected to have different driving patterns as they are not as range-limited. According to VoltStats.net, a voluntary subscription site that automatically downloads basic driving information from the OnStar systems on members' Volts, the 27 Volt-driving members in North Carolina have driven over 203,000 miles since November of 2011, 80 percent of which have been in all-electric mode (per monthly average)⁴¹. Monthly records spanning from November of 2011 to October of 2012 show an average overall MPG of 207.7, although this does not take into account the energy cost of the all-electric miles as the EPA estimated 94 combined MPG does⁴². Still this is an important figure for the personal economy of the Volt driver in NC, and the basis for the competition among Volt owners recorded on this website to try to go the farthest between fill-ups.

For fleet PEV users in NC, the majority of their vehicles travel less than 50 miles per day and then return to a common parking area⁴³. According to this usage pattern, any of these vehicles that are used for light-duty applications could easily be replaced by BEVs, especially as larger truck and SUV-style BEVs such as the Ford Transit Connect Electric and the Toyota Rav 4 EV are coming onto the market.

Lithium Production and Battery Recycling

North Carolina has a long history with the lithium needed to manufacture the batteries used on most production PEVs. In the early 1950s, and for most of the following 50 years, a mine in Kings Mountain, North Carolina produced most of the world supply of Lithium⁴⁴. The original company that owned the Kings Mountain mine is now owned by Rockwood Holdings of Princeton, NJ, which continues to mine lithium around the world. Representatives from Rockwood Lithium presented to the NC PEV Taskforce on June 19, 2012 and affirmed that lithium mining in NC is still possible, depending on the future price of the material. Raleigh is also home to Umicore – a branch of an international materials technology firm. Among other interests, Umicore recycles the large lithium batteries used in PEVs⁴⁵. With this kind of internationally significant trade in new and recycled lithium, NC may be well-placed for economic development as PEV markets increase around the world.

Conclusions

The auto manufacturers were very knowledgeable and supportive of our planning efforts. They will continue to be valuable partners as we move forward with the implementation of this plan and as new vehicles and technologies are developed. EPRI is another leader in the field of PEV research and has made significant contributions to this plan through its authoritative estimates of the current total cost of ownership and future PEV adoption. The NC PEV Taskforce should continue to partner with them both directly and through our utility partners to stay apprised of the most current objective assessments of PEV technology and markets.

Data from the NCDMV tracking the number, types and locations of registered PEVs in the state will continue to underpin our future efforts in planning for the adoption of electric vehicles. Other states involved in similar planning efforts have had much more difficulty in getting data on the number of registered PEVs. In conversations facilitated by RMI, NC was held up as one of a small number of states that have been successful. As mentioned previously, some of these states track PEVs through VINs instead of by make and model, and some must get the whole database of all registered vehicles and narrow the list down for themselves. It is not uncommon for these organizations to have to pay an annual fee to get this data. In this context the NCDMV stands out as a leader in the country for having a clear data request system in place that is backed up by state law, and provides understandable and reliable data. The NC PEV Taskforce could help to share the NCDMV's best practices with other states and partners including the American Association of Motor Vehicle Administrators (AAMVA).

In the future, the NC PEV Taskforce may be able to assist the NCDMV in various ways and continue to build a mutually beneficial relationship. One challenge that the NCDMV faces is to track vehicle data in a reliable and consistent way while this data is being entered in more than 100 separate local DMV offices and in hundreds of auto dealerships across the state. The introduction of PEVs with various different power trains and fuel types adds another layer of complexity. One example of the errors that can result from this distributed system in categorizing the fuel type of the Chevy Volt. Of the 429 Chevy Volts registered in the state, nine percent of the time they are listed as all-electric, 68 percent of the time they are listed as gasoline-only, and only 24 percent of the time they are listed correctly as hybrid-electric and gasoline vehicles.

The NCPEV Taskforce has already begun an education campaign across the state to inform PEV users and auto dealers in the differences between the types of PEVs. This may help on the local level to increase the accuracy of data entry at vehicle registration. Another step that could be made to improve accuracy would be to add a "plug-in" code to the fuel type or another field on the registration form. This would simplify the classification of a variety of vehicles as well as the process of finding those vehicles in the database once entered. Online systems that have built-in verification software have already been discussed by groups like the NC Traffic Records Coordinating Committee⁴⁶. As it seems that no new developments have been posted by this group this year, it is unknown whether this recommendation is being implemented. If this system has not yet been implemented, the support of the broadly representative NCPEV Taskforce may help the NCDMV justify the required investments.

Finally, the NC PEV Taskforce could help to develop and advertise a new way to market blocks of Green energy that would help to promote the use of electric vehicles. One of the stumbling blocks that many would-be EV drivers have is that our nation's electricity grid has the reputation for being dirty. Scientific studies such as one recently published by the Union of Concerned Scientists⁴⁷ shows that in many areas of the U.S. switching from a fuel-efficient hybrid to an all-electric PEV reduces greenhouse gases overall. Despite this research, some people will have the perception that driving a gasoline car is still cleaner than an electric car that is powered by a grid they perceive to be "dirty". While this impression may change with increased outreach and education, for now it points out a market opportunity. In NC, utility customers can purchase 100 kilowatt-hour blocks of green energy from a non-profit that's supported by the utilities called NC GreenPower. Each block costs \$4 per month. This means that in NC it is possible to drive solely on green electricity for only \$1 per 74 miles.

Supporting Calculations:

- 1 gallon of gasoline = 33.7 kw-hr
- 99 mpg equivalent for a 2012 LEAF
- 99 miles/33.7kwh = 2.94 miles per kWh for a 2012 LEAF

<http://www.fueleconomy.gov/feg/Find.do?action=sbs&id=32154> Considered a conservative estimate (EPA 5cycle test - <http://www.plugincars.com/nissan-leaf-finally-gets-official-epa-label-106486.html>)

As this program could directly address the perceived obstacle of the “dirty grid” at low cost to consumers, it could help OEMs and dealerships make the case to prospective buyers in NC. With their help, this could become a program offered through dealerships and even added into a PEV lessee’s monthly payment. This marketing strategy can be easily replicated in other states with public or private green energy programs similar to NC Green Power.

Recommendations

The following recommendations were derived from the expert presentations to the Vehicles Working Group and the discussions that followed during and after our meetings.

Table 3. Vehicles Working Group Recommendations			
	Recommendation	Time Frame*	Priority Level**
R.1	Continue to build a relationship with the NCDMV and explore how to work in complementary ways	Ongoing	High
R.2	Publicize data on current and expected prevalence of NC PEVs and EVSE to demonstrate that the technology is feasible and accessible.	Short-Term	High
R.3	Share the business case for PEV usage with public and private fleet managers among the NC Clean Cities Coalitions to increase early adopter market.	Short-Term	High
R.4	Work with PEV dealers to create a package for prospective PEV owners that allows them to offset all of their vehicle-based electricity use with blocks of green energy.	Short-Term	High
R.5	Work with the NCDMV to add a “plug-in” code to the fuel type tracking field at vehicle registration.	Short-Term	Medium
R.6	Work with the NCDMV to create an online system for vehicle registration to diminish user error.	Long-Term	Medium
R.7	Continue to engage with MPOs and other planning entities in the state to align priorities, provide mutual support, and avoid overlapping efforts.	Mid-Term	Medium
*Term Lengths for Recommendations			
	Term	Description	
	Short-Term	1 to 2 years	
	Mid-Term	3 to 5 years	
	Long-Term	6 to 10 years	
	On-going	No set start or end time	

INFRASTRUCTURE



4

Authored by:
NC PEV Taskforce Infrastructure Working Group

Led by:
Duke Energy

INFRASTRUCTURE

The transportation sector has already been proceeding down the path of electrification for more than a decade as evidenced by the growing adoption of standard hybrid electric vehicles (HEVs) such as the Toyota Prius. Although these vehicles still source all of their energy from an internal combustion gasoline engine, the incorporation of larger batteries, an electric motor, and associated components has helped improve fuel economy while advancing the technology and making it more affordable. PEVs take electrification a significant step further by storing electricity provided by the local electricity grid onboard the vehicles. This provides a critical diversification of energy sources that can power the transportation sector using cleaner, cheaper, and domestic energy. However, it also introduces a paradigm shift in how vehicles are fueled or charged in this case. This document will focus on the background, activities, best practices, as well as existing and future charging station needs to fuel plug-in electric vehicles in the state of North Carolina.

NC PEV Taskforce: Infrastructure Working Group

Goals and Objectives

The objective of the NC PEV Taskforce Infrastructure Working Group was to develop recommendations, best practices, and forecasts related to electric vehicle charging infrastructure deployment to enable widespread plug-in vehicle adoption in the state of North Carolina. The following goals were outlined to support the team's objective:

- Pull together educational information and resources regarding charging technology/vendors.
- Develop educational information and resources regarding the installation of charging infrastructure including best practices, flowcharts, and solution providers for all customer types.
- Develop ideal charging location considerations, macro and micro, to meet customer needs.
- Assess current market deployment of charging infrastructure and forecast future market needs along with ideal ratios of public stations related to future vehicle adoption.
- As available, collect current costs of installing charging infrastructure and provide recommendation to reduce costs as needed.
- Assess potential impact of PEVs on the grid and provide recommendations to address future grid impact concerns.
- Identify a range of infrastructure solutions and business models along with any recommendations to improve the marketplace.

Members and Backgrounds

In late 2011, the NC PEV Taskforce Infrastructure Working Group was formed to address questions and issues related to providing adequate charging infrastructure in the state of NC to support plug-in vehicles. The working group members included individuals from a wide variety of sectors, all who volunteered to participate in varying degrees over the course of the project. Thanks to all of those who contributed to the success of this initiative. The full list of working group members is included in the beginning of this plan.

Guest Speakers and Contributors

On several occasions, guest speakers were invited to provide their perspective and lessons learned on charging infrastructure. These speakers include:

- Barbara Rogers with Ford Motor Company
- David Peterson with Nissan North America
- George Bellino with General Motors
- Stephanie Cox with Ecotality
- Morgan Davis with the Electric Power Research Institute (EPRI)
- Marco Palmeri, consultant for EPRI
- Rob Schurhoff, consultant for EPRI

Deliverables

The following deliverables were developed by the team and will be covered in detail through the remainder of this chapter. Note that although the wording may be different, these deliverables incorporate the key elements of the suggested U.S. DOE's PEV planning guidance:

1. Complete a market assessment on charging infrastructure deployments throughout North Carolina today and future forecasts out through 2030, both at the state level and at the community level.
2. Develop resources on charging infrastructure technology, features, considerations, and vendors.
3. Provide best practices for installing charging infrastructure including known codes and information on optimal location within a specific site.
4. Develop optimal "macro" state level guidance for locating public infrastructure and an ideal ratio of stations to vehicles to accommodate the market while minimizing investment.
5. Preliminary assessment and estimates of the cost of local installation of charging stations by category and suggestions to minimize costs.
6. Identify a range of potential ownership models, value proposition, pros and cons, and potential sources of funding/cost recovery for commercial/public infrastructure.
7. A description of utility, grid operator, or third-party charging service provider, policies and plans for accommodating the deployment of plug-in electric drive vehicles in NC. [Note: This deliverable has been transferred to the "Utility" section of the NC PEV Roadmap]

Introduction to PEV Charging Infrastructure

Key Charging Terms

Charger is a device to change alternating power (AC) wall power into direct current (DC) power for charging the battery. For AC charging levels defined in the SAE-J1772™ standard, the charger itself is located onboard the vehicle. For DC charging levels, the charger is located within the electric vehicle supply equipment off board the vehicle.

Electric Vehicle Supply Equipment (EVSE) provides AC wall power to the vehicle to be used by the on-board charger. This is the external hardware and is an element in an infrastructure that supplies electric energy for the recharging of electric vehicles or plug-in hybrid electric-gasoline vehicles. An EVSE for AC charging levels does not include a charger despite the fact it is often referred to as a "charging station".

EVSEs are generally found in four configurations: Pedestal, Pole, Wall Mount or Ceiling Mount.



Figure 14
Charging station configurations

SAE J1772™ is the Society of Automotive Engineers (SAE) standard for conductive charging. It sets the industry wide standard for the charging connector and communications protocol.

SAE J1772™ AC Connector is known as the “universal plug” designed for single phase electrical systems with 120 V or 240 V such as those used in North America and Japan. The round 43 mm diameter connector has five pins, with 3 different pin sizes:

- AC Line 1 and AC Line 2 (have same size power pins)
- Ground Pin
- Proximity Detection and Control Pilot (have same size pin)

The connector uses a 1 kHz square wave at +/- 12 volts generated by the Electric Vehicle Supply Equipment (EVSE), i.e. the charging station, on the pilot pin to detect the presence of the vehicle, communicate the maximum allowable charging current, and control charging. Practically all new plug-in electric vehicles are standardized on the J1772™ connector.

SAE J1772™ AC/DC Combo Connector is a new standard that expands the standardized SAE connector listed above to also include the ability to charge with low and high power Direct Current (DC) electricity. This is enabled by the addition of two DC pins below the existing AC pin design as depicted in the figure below. Despite the new functionality, the vehicle ports and connectors will maintain backward compatibility with the AC Level 1 and 2 charging levels. The largest seven automakers in the U.S. and Europe have all agreed upon this new SAE standard to incorporate DC fast charging capability in future models, some expected in 2013. Note that some Japanese auto manufacturers are currently using a Japanese DC fast charging connector and system called CHAdeMO and at the time of this report publishing have not agreed to adopt the new SAE combo connector solution for DC fast charging.

CHAdeMO DC Fast Charging is the trade name of a fast charging solution currently adopted by several Japanese automakers to deliver up to 62.5 kW of DC power via a specialized connector. Several early battery electric vehicles in the marketplace that currently offer this solution as the SAE North American standard was not in place when the vehicles were developed. Although the European and North American automakers have announced their plan to incorporate the new SAE combo connected standard, it is possible that some Japanese automakers will continue with this solution. Note that all vehicles will still be capable of utilizing the SAE AC level 1 and level 2 connector and charging levels regardless of the DC charging solution, although the CHAdeMO option will require a separate DC charging inlet in addition to the AC inlet.

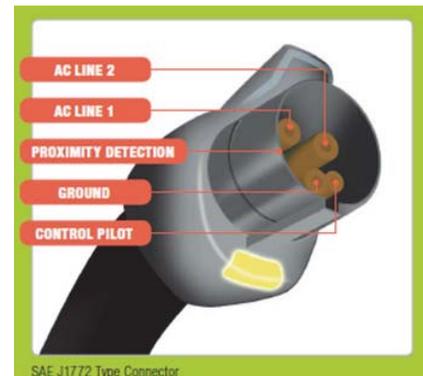


Figure 15 SAE J1772™ AC Level 1 and Level 2 Connector



Figure 16 SAE J1772™ “Combo” Connector for DC Level 1 and Level 2 Charging. Courtesy SAE International.



Figure 17 CHAdeMO DC Fast Charge Connector in Vacaville, CA

Wireless Charging is a technology that utilizes magnetic resonance to charge a vehicle without a physical connection to the vehicle. Energy is transferred from a transmitting coil in the parking pad located on the ground and converted into an electrical current by the receiving coil mounted under the vehicle. Standards are still under development for this technology although prototypes are available today from several companies.

Inductive “Paddle” Charging uses electromagnetic fields to transfer energy between a vehicle and a charging appliance without a direct conductive coupling. Although similar to wireless charging, this technology does not transmit through an air gap but rather utilizes a “paddle” that is inserted into an opening on the vehicle side. This is a legacy technology used with previous generations of electric vehicles and it is not currently used in newer vehicles.

Access to Charging Infrastructure

Using electricity to charge a vehicle and power transportation will necessitate a paradigm shift in how vehicle owners are used to “fueling” their vehicles. In the past, a gasoline vehicle owner might typically wait until the fuel gauge is close to empty and then pull into any one of numerous public gas stations. Over the course of five to ten minutes, the driver will transfer 10 to 15 gallons of gasoline into an average light duty vehicle providing another 250-300 miles of range. With PEVs, the paradigm will shift from infrequent and large transfers of energy (range) to more frequent but smaller transfers of energy.

Although battery technology is rapidly advancing, batteries in PEVs still have a lower effective energy density compared to gasoline vehicles. This means that to provide the same range in miles that drivers are typically used to with gasoline vehicles PEVs would require a very large and heavy battery. This in turn would drive the cost up for the vehicle and the fuel efficiency down. However, PEVs are able to leverage several factors that still allow them to fulfill the driving needs of most consumers:

1. Most daily driving patterns are relatively short, allowing for modest sized battery electric vehicles (BEV) to be affordable and still provide over twice the range that drivers travel on an average day. An EPRI analysis of a national commuting pattern survey showed that nearly 80 percent of total daily driving distances are less than 40 miles and nearly 95 percent are less than 100 miles. Note that with plug-in hybrid electric vehicles (PHEV) or extended range electric vehicles (EREV), there is no effective range limit as a gasoline engine can take over once the batteries are fully depleted.
2. Vehicles spend more than 95 percent of the time parked not in use. A vast majority of this time is at home, but also at workplace and commercial locations. All of this downtime allows a vehicle to replenish its battery charge over a longer period of time while not being attended by the driver. Frequent “topping off” of a plug-in electric vehicle can also enable greater range for battery electric vehicles and a greater utilization of electric drive for plug-in hybrid electric vehicles.
3. Although gas stations are numerous especially in high density regions, a gasoline vehicle driver still depends on accessing a public station for all of their fueling needs. Access to electricity on the other hand is ubiquitous and while some public charging will be necessary, the vast majority of charging will take place in the convenience of a driver’s residence.

So instead of weekly trips to the gas station, a PEV owner will likely just plug in at home and charge overnight to achieve most of their fueling needs, perhaps with the occasional charge at work or at a public station. Figure 18 is a visual approximation from EPRI of the three main categories of charging and their relative use.



Figure 18 EPRI Charging Pyramid

Residential Charging

Residential charging, or charging at a fleet depot for fleet vehicles, will accommodate the vast majority of charging needs for most vehicles. As noted before, electricity service is provided at practically every location although access to a dedicated circuit or outlet close to a vehicle's parking location may need to be verified. Since residential and fleet depot charging is often dedicated to specific vehicles privately owned, this category is normally considered "private."

Workplace Charging

The second most utilized location for charging will likely be at the workplace. The dwell times for vehicles are the second longest behind the home, often 8-9 hours, providing more than enough time to replenish the electricity used on the drive to work. Many companies view providing access to charging infrastructure for their employees as another fringe benefit and a way to differentiate themselves in the competition for talented employees. SAS, Qualcomm, Siemens, and Bank of America are just a few major employers in North Carolina that already provide such access to charging infrastructure at work. Although some employers may opt to make their chargers available to the public, this category is often reserved for employees and thus considered "private."

Public Access Charging

Public charging access is represented as the tip of the pyramid – the least likely to be fully utilized, but still fulfilling a critically important role. First, they provide peace of mind for those driving pure battery electric vehicles by increasing the effective vehicle range of BEVs when needed and providing confidence for those occasional trips where the total range might be tested. Second, it provides the opportunity to replenish PHEVs and EREVs so that they can maximize their electric drive utilization and thus their return on investment. Finally, these stations provide vital access to those who may not have access to charging at home (e.g. downtown condos) or at work.

Types of Charging Stations

Table 4. Types of Charging Stations				
Applications	Private	Private/Public/Commercial	Private	Private/Public/Commercial
Charging Site	Home/Work: Employee	Home/Work/ Retail Stores/Restaurants/ Parking Lots	Home/Work: Fleet	Highway Rest Stops/ Retail/Valet/Multi-unit Dwellings/Fleet Depots
Miles Recovered Per Hour of Charge	Approximately 4 mi	Approximately 10-20 mi	Approximately 10 mi	Approximately 140 mi.
EV Usage	Short-Mid Distance	Mid-Distance	Mid-Distance	Long Distance/Heavy metro usage/no home charging access
Outlet Style	Standard NEMA 5-15 or 5-20 outlet	Hardwired or plugged into 240 volt NEMA outlet	Inductive charger connected to 240 volt circuit	Hardwired to three-phase power
Voltage	120V single-phase	208/240V single-phase	208/240V single-phase	208/480V three-phase
Amperage	15 or 20 amp wall outlet (3-prong)	20 to 50 amp circuit	30 amp circuit	Varies based on voltage, but often rated 20-50 kW
Connection	Cord & Plug Connection	Hardwired or Cord & Plug Connection	Line 1, Line 2, and Earth Connection	Hardwired
EV Connector	J1772 AC Connector	J1772 AC Connector	Wireless interface that mimics J1772 connector – standard pending	SAE AC/DC Combo Connector (expected mid-2012) or CHAdeMO
Cost	Typically comes with the vehicle although extras are ~\$500-900	Basic: \$500 - \$4,000 Smart: \$2,000-\$8,000	\$1,000 - \$3,000	\$15,000 - \$50,000
Charge Time for Typical 35 Mile Charge	9 – 12 hours	2 – 4 hours	3 – 4 hours	15 – 30 minutes *Note: DC fast charging is not linear and may take as long to add 35 as 70 miles of range

Pros and Cons of Different Charging Station Levels

Table 5. Pros and Cons of Different Charging Station Levels		
Applications	Pros	Cons
<p>AC Level 1 EVSE</p> 	<ul style="list-style-type: none"> • No incremental cost since it comes with the car • Available where there is a standard 120 volt electric outlet • Portable – easily stowed in car • Demand impact to the grid is minimal • No need for network interface 	<ul style="list-style-type: none"> • Limited current up to 16 Amps (2 kW) and long charge time • Not accessible on the grid or recognizable for utility to do load sharing or load balancing • Equipment is liable to theft if charging in public • No easy options for data logging or restricting access • Requires slightly more setup time than permanently installed EVSEs
<p>AC Level 2 EVSE</p> 	<ul style="list-style-type: none"> • 3-5 times faster charging compared to Level 1 • Low set up time for charging • More feature rich, some with remote monitoring and control • Not as prone/exposed to theft 	<ul style="list-style-type: none"> • Costly to install, requiring professional installation • Not portable • Cord management difficult and can be maintenance prone • More upgrades require yearly service plans
<p>Wireless Charging</p> 	<ul style="list-style-type: none"> • Easy to use with no physical connection to initiate charging • Capable of charging at equivalent AC Level 2 charging levels (3-6 kW) • No cord tripping hazard • Best suited for home and fleet use 	<ul style="list-style-type: none"> • Slightly less efficient compared to conductive charging and alignment can be important • Standards not yet fully agreed upon • Difficult to use as a public stations due to lack of system and alignment conformity • Mostly an aftermarket solution currently
<p>DC Level 2 Charging</p> 	<ul style="list-style-type: none"> • Fast charging under 30 minutes • Close connection to batteries avoiding step of AC-DC conversion and losses • Implementation of communication between EVSE and EV with safety features that Level 2 does not provide • Makes long distance commutes more practical • Low set up time for charging • More feature rich, some with remote monitoring and control 	<ul style="list-style-type: none"> • Expensive EVSE & installation cost • Confusion and competition over SAE combo and Japanese charging connector • Utility demand and new service related charges can be significant • Requires three-phase power • Not portable • Difficult business model to recoup expenses with limited use

Charging Station Operational Features

Charging infrastructure is available in its basic form or with a wide array of features. The basic hardware provides all the necessary safety features and communication compliance with SAE J-1772™ to safely and cost effectively charge your vehicle. In fact, the portable AC Level 1 cord set provided with most vehicle purchases will suffice for most residential and workplace home charging requirements in many cases. However, if you are looking to purchase and install a charging station for your vehicle or as a host site for public use, you may wish to consider the following features offered by many vendors. Every feature will add some cost, so be sure to fully understand the value provided and if it's worth the cost or enables your specific need. In most cases, the features below are available for both AC Level 2 and DC Level 2 charging equipment.

Table 6. Charging Station Operational Features		
Optional Features	Pros	Cons
Cord Holder	<ul style="list-style-type: none"> Keeps the cord organized and out of the way of parking spaces, sidewalks and streets Enhances safety 	<ul style="list-style-type: none"> Adds minimal cost
Retractable Cords	<ul style="list-style-type: none"> Keeps cord organized and out the way of parking spaces, sidewalks and streets Enhances safety 	<ul style="list-style-type: none"> More expensive than just coiling it up yourself May require higher maintenance
LED Display Status	<ul style="list-style-type: none"> Provides you the status of your charge Energy efficient 	<ul style="list-style-type: none"> No real standard on what colors/symbols mean
Radio Frequency Identification (RFID) Reader	<ul style="list-style-type: none"> Allows station owners/operators to restrict usage to authorized drivers by requiring a RFID card to initiate charging Enhances safety and eliminates energy theft RFID software registers usage of the EV Charging Station, enabling data collection by user 	<ul style="list-style-type: none"> If the charging station is for public use then the RFID reader will require providing the public a RFID card to utilize the charging station Each individual vendor network solution requires a unique RFID membership and can result in a single driver needing many cards Although some solutions can be managed locally, this often requires the station operator to subscribe to a networked service solution
Energy Meter	<ul style="list-style-type: none"> Provides accurate energy and power measurement through the station with integrated power metering circuitry Avoids having a separate official utility meter and the associated added fixed cost on the energy bill Allows station operators to know exactly how much energy and power is consumed by the vehicles 	<ul style="list-style-type: none"> Adds cost Accuracy and precision can vary significantly Requires a communication medium if not wireless which requires extra cost and equipment When stations are wired behind a main facility utility meter, you cannot separate out the energy/cost associated with vehicle charging on the main bill For private use, high level energy information is often provided via the vehicle
Network Interface (cellular)	<ul style="list-style-type: none"> Cellular network interface allows seamless integration network application services from nearly any location, direct from the station Does not require ethernet/CAT5 cable installation or integration with a local router 	<ul style="list-style-type: none"> Adds equipment cost and ongoing monthly communication costs Can have spotty reception in mountainous or remote locations, or inside parking structures

Table 6. Charging Station Operational Features

Network Interface (wireless)	<ul style="list-style-type: none"> • Wireless network interfaces allow seamless integration network application services from a station to a local router and through the internet • Eliminates cellular communication and modem charges • Does not require ethernet/CAT5 cable installation 	<ul style="list-style-type: none"> • Adds equipment cost and likely still requires some software application costs • Requires integration with host site router and internet connection, which can be very difficult unless for private use
Network Interface (Ethernet)	<ul style="list-style-type: none"> • Ethernet network interfaces allow seamless integration network application services from a station to a local router and through the internet • Eliminates cellular communication and modem charges • Hardwired and secure with no reception/wireless issues 	<ul style="list-style-type: none"> • Adds equipment cost and likely still requires some software application costs • Requires separate conduit to run communication line and a host site server/router
Software Application Services	<ul style="list-style-type: none"> • Set pricing and collect fees, provide 24/7 driver assistance, control access, display advertisements, track usage, and diagnose the station remotely • Most often used in conjunction with RFID controlled access 	<ul style="list-style-type: none"> • Monthly or yearly activation/subscription fee
Credit Card Reader	<ul style="list-style-type: none"> • Set pricing and collect fees without the need of a RFID card or membership system 	<ul style="list-style-type: none"> • High maintenance for credit card reader • Services/transaction fees can be significant compared to cost of fuel
Numeric keypad module	<ul style="list-style-type: none"> • Set pricing, collect fees, and control access through local synchronous codes • Can leverage user's cell phones and avoids costly communication hardware and ongoing service fees 	<ul style="list-style-type: none"> • Incremental cost of keypad module and code maintenance fee • Does not provide central data monitoring or other features commonly associated with other back office applications

Charging Station Manufacturers and Pricing

The number of companies offering electric vehicle charging hardware and service is growing all the time making it impossible to capture in this static report. Pricing is also very fluid, with some costs declining with increased competition and volume, and an array of features that can be added to the final cost. As such, we have provided several recommended internet resources for potential consumers to further investigate charging infrastructure vendors and research their associated hardware and service costs:

Online Resources for Charging Infrastructure Vendors

- www.goelectricdrive.com/index.php/find-an-ev-charger
- www.advancedenergy.org/transportation/evse/
- www.pluginamerica.org/accessories

Charging Infrastructure Value Proposition and Business Models

While essential to the fueling of plug-in electric vehicles, the value proposition and rationale behind who owns and operates the charging infrastructure can vary depending on many factors. Below are a few broad categories although variations will always exist:

Direct Private Use for a Dedicated Vehicle

This scenario is the most common since most every plug-in vehicle owner, whether the general public or a fleet operator, will own some type of charging infrastructure to be used directly by their own vehicles. In most cases, the actual vehicle owner will also own the infrastructure. The charging station in this case is simply a required component of operating the vehicle and the cost should be incorporated into the overall total cost of ownership for the vehicle. Although some charging solution is required, some owners may opt for a low cost AC Level 1 cord set while others may value the more expensive but faster charging AC Level 2 solution.

Private Use by Employees

In this scenario, a business may decide to invest in charging infrastructure for use by its employees. The ownership of the charging infrastructure would be separate from those who own the vehicles. In many cases, the business may cover all of the associated costs and simply consider it part of its “fringe” benefits. Many companies in North Carolina have already deployed charging stations in such a manner and consider it an important benefit to attract and retain the best talent. Other businesses may pursue this path as part of their overall strategy in reducing their environmental footprint or supporting domestic energy solutions. Since these factors are not easily quantifiable, the business rationale will vary from business to business. In some cases, business are exploring the option to charge a service fee to employees that utilize the infrastructure in order to recover some or all of their investment, however there is usually no direct profit motive and there are added costs and complexity to incorporating such mechanisms.

Municipal Public Charging Access

Several municipalities in North Carolina have deployed a number of public access charging stations to encourage and accelerate the adoption of electric vehicles to achieve the benefits of lower fuel costs, lower emissions, and greater energy security in their regions. For some local governments, the deployment of charging infrastructure fits well within their overall sustainability strategy and objectives. In many cases, early adopters are not necessarily charged a fee to access the stations due to the early stage of adoption and the valuable usage data gathered by the deploying entity. However, several municipalities are closely monitoring station usage and payment system technologies in order to plan for future cost recovery if necessary. Each municipality will need to weigh the value they assign to encouraging PEV adoption and how providing a safety net of charging access aligns with providing for the public benefit.

Privately Owned and Operated to Support Retail Business

Many retailers and other private businesses opt to install charging station not to profit directly from their use, but to increase the sales of their core businesses. They believe that providing such an amenity will increase their exposure, bring in new customers from a desirable demographic, and increase existing sales while customers wait on their car to charge. Those businesses that are involved early will be the most successful at differentiating themselves from other similar businesses and branding themselves as a PEV friendly place for customers. Since direct cost recovery at the charging station is not usually necessary, the infrastructure can be kept relatively simple and low cost.

Privately Owned and Operated as Stand Alone Business

This scenario assumes that the station owner/operator is not only attempting to recover costs but also to directly profit from the use of a public charging station through service or access fees. This is a complicated and difficult scenario as the cost of installing public infrastructure is relatively high compared to the cost that a user would be willing to pay for a charge. Although a user may be willing to pay more if they have a BEV close to empty, a driver will often have the cost comparison of only \$1.00⁴⁸ to charge at home and plug-in hybrid drivers always have the option of driving on gasoline if necessary. This provides a relatively small window to charge consumers without charging too high a price that will reduce utilization. This is in fact a challenge with public charging infrastructure: Despite its vital importance in supporting PEV adoption, utilization will be relatively low (compared to gas stations) thus making cost allocation difficult. However several companies are exploring ways to find a commercially viable stand alone business model. Some rely on a direct “fee for service” payment system while others are exploring more innovative ideas such as membership models and supplemental advertising revenue from the station space itself.

Utility Owned and Operated for Public Benefit

In this case, a utility would own and operate public charging infrastructure for public benefit similar to street lighting. This scenario is also complicated due to the unusual customer/asset relationship as well as the associated regulatory, cost recovery mechanisms, and other policy considerations. Several municipal owned utilities that operate under different regulations than investor owned utilities are currently experimenting with this role including Austin, Orlando, and San Antonio.

Charging Infrastructure Installation Best Practices

Following the decision to install a charging station, the next steps are:

1. Determine the best location for the charging station installation;
2. Select an appropriate charging station technology, based on the location selection; and
3. Decide the details of equipment ownership and operation.

This section outlines the various charging station installation scenarios and provides recommendations and resources for overcoming the common challenges associated with each location type. Since much of this work has been outlined in greater detail by Advanced Energy and others, the following is only a high level summary and readers are encouraged to visit the resources outlined in each section for additional information.

Single-Family Homes

Single-family dwellings are buildings that are occupied by just one household or family and consist of just one dwelling-unit or suite. Most single family homes are free-standing and do not share property with any other residence. Common charging station installation challenges for single-family homes include:

Parking Location

Single-family residential parking scenarios can vary from private garages and driveways to detached carports or on-street parking. To identify the best-fit installation location:

- Assess available vehicle charging options
- Consider the planned parking scenario and time of use.

Utility Access

Electrical requirements will vary, depending on the charging level selected. Level 1 charging utilizing a standard 120 volt household outlet and a provided cord set is the simplest and most easily accessible method for home charging. Although many homes may have a readily available 120 volt circuit, it is also likely that such an outlet is often shared with other residential appliances and loads. It is recommended that a dedicated 120 volt circuit be installed as most vehicles will draw the maximum amperage possible (80% of a 15 or 20 amp circuit) and any additional/intermittent loads on the circuit, such as a garage freezer, may trip the circuit breaker leaving a car uncharged. In addition, it is recommended that a standard existing residential outlet device be replaced with a new, high end “commercial” grade outlet. These outlets are designed with more robust contact blades to handle a higher number of insertions and will help provide added safety with the higher amperage load and high number of inserts expected with a plug-in vehicle. A licensed electrician can help any homeowner assess their current situation and make any recommendations. Another benefit of low power Level 1 charging is that it is highly unlikely that any home’s power panel or the utility’s distribution system would need to be upgraded.

AC Level 2 charging is an option for those wishing to charge 3-5 times faster than Level 1. AC Level 2 requires specialized charging equipment, called electric vehicle supply equipment (EVSE), and a dedicated 208/240 volt circuit similar to a clothes dryer. While the 120 volt portable charge cord is often supplied with the vehicle, the vehicle owner would need to purchase the EVSE required for AC Level 2 charging. There are variations on how the EVSE can be wired to the circuit, including a direct hard wire or a pig-tail cord and plug connection that can be plugged into a NEMA 208/240 volt outlet for ease in future relocations. In either case, the unit is expected to be secured as a stationary device while charging the vehicle. Installation costs alone can vary greatly depending on the cable run length, trenching requirements, and power panel capacity but typically range from \$300 to \$2,000. Most auto dealers will have a preferred EVSE vendor and electrical contractor, but customers can also opt to call their own preferred electrician. Note that in some cases, an upgrade to the home’s power panel or the utility’s distribution service (i.e., the amount of power available to the home) may be required for the addition of higher power vehicle charging loads. Be sure to contact the utility provider to inform them of the new load and inquire into whether a power service review is necessary. An electrician should also notify a homeowner to contact the utility if it’s determined that the home’s power panel must be upgraded to allow for another circuit. If an electrical service upgrade is needed inside or outside the residence, installation costs can be significantly higher.

Electric Rates

Many utilities offer a reduced rate for off-peak charging. Check with the local utility provider to see if a residential time of use rate or load control incentive might be available.

Resources for Installation Recommendations and Best Practices:

- *Advanced Energy’s Charging Station Installation Handbook for Electrical Contractors*
www.advancedenergy.org/transportation/resources
- *Clean Cities Plug-In Electric Vehicle Handbook for Electrical Contractors*
www.afdc.energy.gov/publications
- *DOE/Alternative Fuel Data Center – Infrastructure*
www.afdc.energy.gov/fuels/electricity_infrastructure.html
- *EDTA/Go Electric Drive – Home Charging*
www.goelectricdrive.com/index.php/home-charging

Multi-Family Homes

Multi-unit dwellings (also known as multi-family residences) are a classification of residential housing where multiple housing units are contained within one building, or several buildings within a complex, such as town homes or apartment buildings. Some multi-unit residences may contain condominiums where one or more units are owned individually rather than rented or leased from a single building owner. Common charging station installation challenges for multi-family homes:

Parking Location

Multi-family residential parking scenarios can vary greatly, from private garages, carports, and driveways to on-street parking, parking lots, and decks. To identify the best-fit installation location:

- Assess the available vehicle charging options
- Consider the planned parking scenario and time of use
 - If the parking space can be dedicated to the PEV owner allowing for long period charge times, than a low power AC Level 2 or a Level 1 may be preferred.
 - If the space is meant to be used by multiple tenant putting pressure on throughput, then a higher power charging level would be preferred.

Utility Access

In addition to the information provided in the Single Family Homes “Utility Access” section, the following clarifications would apply for multi-family unit dwellings. One difference is that installation costs will likely be higher due to the complexity and differences of where people park, live, and have access to electricity along with the higher likelihood of special construction needs such as trenching and paving. Another complexity, as outlined later, is that electricity metering and its access point is much more complicated. Even if 120 volt outlets exist in the common grounds, it is still highly recommended to have these evaluated by an electrician to ensure integrity and capacity, and to review with the building manager to ensure that use is allowed and it does not cause a pedestrian tripping hazard. As before, it is important to:

- Identify the owner of the power supply
- Develop an agreement that allows for the supply to be used

If the user does not own the parking location or power supply, it is important to gain approval from all applicable groups, such as property/building owner and/or home owner associations, prior to any installation work.

Electrical Metering

The question of who pays for the electricity used for vehicle charging and how it is paid can be very complex. There are several different methods for metering electricity use in multi-family residences and determining the amount of electricity used per vehicle can be challenging.

Residential Metering: Each tenant’s electricity is metered by a dedicated electrical meter. Often the meters are grouped together in one location to make meter reading easier for the electric utility. Residential metering may make it easier to navigate the complexities of charging station installations at multi-unit dwellings; however, this is not always the case. It may not be cost feasible to route the electricity supplying your charging station through your dedicated electric meter.

Master or Group Metering: A single meter that measures electricity usage for an entire building or area without distinguishing amongst the included areas/units. In this metering scenario, it will be difficult to determine the electrical consumption for a single tenant’s charging station.

Common Area Metering: A meter that measures the electricity usage in common areas, such as parking lots, laundry rooms and pool areas. It may be more cost feasible to connect a charging station to a common area meter, but as with master or group metering, it will be difficult to determine the electrical consumption for a single tenant’s charging station.

With any of these metering cases, it is very important to consult with both your building or property owner and your electric utility to determine the best metering option for your charging station. In some instances, residential electrical loads can be sub-metered to capture usage and facilitate proper allocation of charges and billing; however, sub-metering in this manner is not always permitted.

Third-Party Approvals

If the residence is governed by a Property Manager or Home Owners Association (HOA), it is recommended that they become involved early in the process to decide which changes can and cannot be made to the property. Come prepared to discuss the benefits of PEVs and how they can benefit the community and environment. Also, check your state's laws and civil codes for information about installing charging stations. (For example, California Senate Bill 880, which went into effect in January 2012, restricts a home owners association's ability to prohibit the installation of charging stations. However, this does not mean that associations cannot control or regulate installations.)

Cost Allocation

In situations where your parking location is owned by another party (e.g., building owner), it is important to decide in advance who will pay for the charging station equipment and installation. There are many pay-per-use features and models that can help support cost-recovery of installation, operation and equipment charges. Additionally, non-permanent installations (i.e. plug-mounted stations) can be easily removed and relocated when the residence or parking scenario changes. Discuss options with the parking facility manager and select a scenario that best fits the individual parking situation.

Electric Rates

Many utilities offer a reduced rate for off-peak charging. Depending on the building's meter set-up an additional meter installation and specific rate selection rate may also apply. Check with the local utility to see if a time of use rate or demand response incentive is available.

Resources for Installation Recommendations and Best Practices:

- *Advanced Energy's Charging Station Installation Handbook for Electrical Contractors*
www.advancedenergy.org/transportation/resources
- *Clean Cities Plug-In Electric Vehicle Handbook for Electrical Contractors*
www.afdc.energy.gov/publications
- *PEV Ready Policy Checklist for HOAs, Owners and Management, Drive Clean California*
www.driveclean.ca.gov
- *Ready, Set Charge California: A Guide to EV-Ready Communities*
www.baclimate.org

Employee Workplace Charging

As employees begin to adopt PEV technologies, employers will be asked to provide workplace vehicle charging opportunities. In these instances, employers will need to:

- Consider the full anticipated charging need;
- Select the appropriate installation locations and equipment; and
- Develop an employee charging policy and procedure.

Common charging station installation challenges for workplace charging include:

Parking Location

Workplace parking scenarios can vary from on-street parking to expansive parking lots and/or multi-level decks. To identify the best-fit installation location:

- Assess the available vehicle charging options
- Consider the planned parking scenario and time-of-use

Utility Access

In addition to the information provided in the Single Family Homes “Utility Access” section, the following clarification would apply for employee workplace scenarios. The difference is that installation costs will be higher due to the higher likelihood of special construction needs such as trenching and paving in a commercial environment. As with the Single Family Home scenario, workplaces may have existing 120 volt outlets however it is recommended that these be fully evaluated prior to use. An electrician should verify that the outlet is dedicated and the outlet is robust enough for its new anticipated use, and the employer will need to verify use is allowed by employees and that it does not cause a pedestrian tripping hazard. This is important since most existing 120 volt outlets are for occasional lighting or landscaping use and are not designed with plug-in vehicle use in mind.

In some cases, an upgrade to the existing electrical service may be required for the addition of a vehicle charging load. Work with the company’s facilities manager to determine the building’s electrical capacity. If an electrical service upgrade is needed, installation costs can be significant.

Policy and Procedures

Employers offering workplace charging also need to consider employee parking policies and procedures. Some common questions regarding workplace charging are:

- Will there be parking restrictions? If so, how will they be enforced?
- Will users require a parking permit or pay a charging fee? If so, how will the fee be collected or permit assigned?
- Will vehicle charging be viewed as an employee benefit? If so, what are the implications (employee equity, tax reporting)?

Electric Rates

Check with the local utility provider to see if a special commercial time of use rate or demand response incentive is available. Many utilities offer a reduced rate for off-peak charging. Restricting vehicle charging to off-peak times may keep electricity costs low although will also limit access by employees during certain time periods.

Resources for Installation Recommendations and Best Practices:

- *Advanced Energy’s Charging Station Installation Handbook for Electrical Contractors*
www.advancedenergy.org/transportation/resources
- *Clean Cities Plug-In Electric Vehicle Handbook for Electrical Contractors*
www.afdc.energy.gov/publications
- *EDTA/Go Electric Drive – Workplace Charging*
www.goelectricdrive.com/index.php/workplace-charging

Fleet Charging

PEV fleets can dramatically reduce business operating costs and assist compliance with government transportation emissions requirements. For fleet charging, determine the number of charging stations required by estimating the size and electrical requirements of your PEV fleet over the next few years. Common charging station installation challenges for fleet charging include:

Parking Location

To identify the best-fit installation location:

- Assess the available vehicle charging options
- Consider the planned parking scenario and time-of-use

If you are considering eventual expansion of your PEV fleet, consider adding extra electrical capacity to support future charging station locations. It is usually less expensive to install extra electrical capacity during initial construction than to modify the site later.

Utility Access

In most fleet applications, AC Level 2 charging is recommended for fleet charging as it can minimize fueling time, maximize vehicle utilization, and efficiently make use of charging infrastructure. Typically this would require a 208/240 volt, 40 amp circuit for each charging station. A single DC fast charger might also suffice in the right vehicle applications where vehicles are simply rotated through the unit to keep fully charged. On the other end, Level 1 charging or low power AC Level 2 charging may work in certain fleet situations where the vehicles can achieve their limited fixed routes within a full charge on a daily basis and then have sufficient time to recharge overnight. In all cases, sites should be evaluated for existing power capacity and proximity to the nearest electrical supply panel.

In some cases, an upgrade to the existing electrical service may be required for the addition of a vehicle charging load. Work with the company's facilities manager to determine the building's electrical capacity. If an electrical service upgrade is needed, installation costs can be significant.

Electric Rates

Check with the local utility provider to see if a commercial time of use rate or load control incentive is available. Many utilities offer a reduced rate for off-peak charging. Restricting vehicle charging to off-peak times may help keep utility costs low.

Resources for Installation Recommendations and Best Practices:

- *Advanced Energy's Charging Station Installation Handbook for Electrical Contractors*
www.advancedenergy.org/transportation/resources
- *Clean Cities Plug-In Electric Vehicle Handbook for Electrical Contractors*
www.afdc.energy.gov/publications
- *Clean Cities Plug-In Electric Vehicle Handbook for Fleet Managers*
www.afdc.energy.gov/publications/
- *EDTA/Go Electric Drive – Fleet Charging*
www.goelectricdrive.com/index.php/fleet-charging
- *Electrification Coalition - Fleet Electrification Roadmap*
www.electrificationcoalition.org/policy

Public Charging

Charging availability at retail locations allows users to charge while they shop, dine, or are just in need of a quick charge. Availability of vehicle charging opportunities at such locations may increase customer visits and lengthen their time of stay. Municipalities may also provide greater benefit to citizens by installing infrastructure in locations where private parking is not located nearby, such as museums, parks, libraries and other high-traffic areas. Common charging station installation challenges for public charging include:

Parking Location

Public parking scenarios can vary from on-street parking to parking lots and decks. To identify the best-fit installation location:

- Assess the available vehicle charging options
- Consider the planned parking scenario and time-of-use

Utility Access

AC Level 2 charging, or above, is recommended for public charging applications. Sites should be evaluated for existing power capacity within the nearest panel as well as at the supplying transformer. Many locations, including parking decks, may have limited capacity beyond one or two charging stations. Planned parking locations and those under construction will greatly benefit by planning for excess power capacity and laying conduit for future charging infrastructure.

In some cases, an upgrade to the existing electrical service may be required for the addition of a vehicle charging load. Work with the site facilities manager to determine the building's electrical capacity. If an electrical service upgrade is needed, installation costs can be significant.

AC Level 1 charging might also be considered for public charging applications where the customer's vehicles may be parked for extended periods of time. This is often the case for commercial hotels, airports, and park and rides of any type where vehicles are typically parked the entire day or overnight. By utilizing AC Level 1 in these cases, the same electrical requirements will be able to often serve twice the number of vehicles as an AC Level 2 installation. This helps to reduce installation and equipment cost while also providing for a doubling of the vehicles and spaces that can be used for vehicle charging.

Policy and Procedures

Retailers and commercial offices that offer vehicle charging opportunities need to also consider customer parking policies and procedures. Some common questions regarding commercial public charging are:

- Will charging locations be reserved for PEV parking only? If so, how will this be enforced?
- Should PEV charging spaces be given a prime location or will that drive up cost and potentially upset traditional customers?
- Will there be parking restrictions? If so, how will they be enforced?
- Will customers pay a fee or require a permit for parking? If so, how will the fee be collected?

Electric Rates

Business owners and municipalities should check with their local utility provider to see if a commercial time of use rate or demand response incentive is available. Many utilities offer a reduced rate for off-peak charging and restricting charge time accordingly may save money, although will also reduce availability to the public.

Resources for Installation Recommendations and Best Practices:

- *Plugging In: A Stakeholder Investment Guide for Public Electric Vehicle Charging Infrastructure*
www.rmi.org/pgr_resources
- *Advanced Energy's Community Planning Guide for Plug-in Electric Vehicles*
www.advancedenergy.org/transportation/resources

For additional resources, see boxes on pgs. 56-60

Charging Infrastructure Installation Costs

The cost to install electric vehicle charging infrastructure can vary greatly depending on many factors. Costs can also be unique to regions of the country due to differences in labor rates, housing construction standards, local codes and how electricity service is planned based on typical load requirements. In order to provide a rough estimate that homeowners or commercial host sites can expect to pay to install a charging station, the working group solicited real world cost data from stakeholders that have deployed charging stations within North Carolina.

Residential

For a vehicle owner seeking to utilize AC Level 1 charging, in many cases there may be no additional costs if a dedicated outlet is available within reach of the desired parking space. For those that need to install a new outlet or upgrade a 120 volt circuit, an electrician might charge \$200 to \$500 dollars depending on the specifics and assuming no abnormal construction is required. For those installing a residential AC Level 2 unit on a 240 volt circuit, the typical cost in NC ranges between \$750 and \$1,500 assuming no power panel upgrades are necessary. The average AC Level 2 EVSE installation cost (excluding the charging station itself) based on more than 100 residential installations in NC (see below).

Residential Install	Average Install Cost	Count
Wall Mount	\$1,098	143
Pedestal Mount	N/A	N/A

Insufficient electrical infrastructure and long distances from the panel to EVSE location (which determine length of conduit run and length of conductor) will increase installation costs. If sufficient supply infrastructure is not in place, costs could range upwards of \$1,500 to \$3,000.

Commercial

The cost of installing a commercial AC Level 2 charging unit for use by the public, employees, or fleet vehicles is typically between \$1,500 and \$5,000. Based on data collected by the working group for a number of commercial installs in the state of NC, the average cost is approximately \$2,000 for a wall mount, ~\$3,000 for a single pedestal unit, and ~\$4,000 for a dual cord pedestal unit. Note that there is a large range in these costs and they are very specific to the power supply and location of a given site.

Below is the typical installation costs and installation options for various unit types provided by regional commercial unit installers. Note this data set includes both costs of actual installations as well as estimates.

Commercial Install	Station Count ¹	Avg Install Cost (per unit)	Avg Install Cost (per cord)
Wall Mount	21	\$2,109	\$2,109
Pedestal Mount	71	\$2,875	\$2,875
Dual Pedestal Mount	10	\$4,129	\$2,064
Optional			
Wheel Stops (each)			\$250
Bollards (each)			\$500
Engineering (per station) ²			\$1,000
Notes:			
¹ Number of installations estimated or performed of this type			
² Assumes site specific engineering drawings are available			

Installation Cost Drivers

Types of Units (Intelligent versus Non-intelligent)

The types of AC Level 2 commercial units typically installed include intelligent and non-intelligent units as well as single and dual mounted units.

Non-intelligent AC Level 2 charging stations simply charge a vehicle and only communicate with the electric vehicle itself. Intelligent EVSE units inherently have to communicate usage and status data either through cellular networks, wi-fi, or hard wired data lines connected to a buildings network. For hard wired installations, installers must run conduit for data lines, pull CAT5 cable, and perform terminations. For wi-fi and cellular based communication, sometimes a repeater may have to be installed – especially in a basement parking garage. Additionally intelligent EVSE units communicate with either premise based software or web based software. Installation or configuration of this software adds additional cost. For most web based systems, there are also the subscription costs or credit card fees.

Types of Installations (Wall versus Pedestal / Single versus Dual)

Commercial units are typically installed using pedestal mounts or wall. Wall mount units have fewer parts and require less metal than pedestal mount units. Wall mount installations are typically less expensive because installers do not have to trench or bore underground, remove and replace concrete structures or contend with other obstacles such as buried irrigation lines, communication lines, etc. Pedestal mounts also require installers to pour a concrete base which also adds cost. Additional cost considerations include landscaping and pavement/sidewalk repair.

For a dual mount installation, installers typically have to use larger conduit, double the number of conductors, multiple circuit breakers in the panel, etc.

Other factors that may influence the cost of installation include:

- Ventilation requirements
- Capacity and location of electricity service supply
- Lighting and shelter needs
- Surge protection requirements
- Permit fees (vary widely)

Cost Reduction Opportunities

Installation costs are driven primarily by the need for trenching, concrete work and signage requirements. Installers typically see lower cost installations when the electric panel is located very close to the charging station install site or when conduit can be run on the outside walls. If a property owner is flexible on the exact parking space or location on a specific site, then installers can usually help them find a relatively lower cost place to install a unit.

To minimize charging station installation costs, property owners should consider the following.

- For new construction, plan for a dedicated breaker in the electric panel for a 240 volt charging station and pre-install conduit for future EVSEs installations. Consider additional panel capacity and conduit runs for additional station installations in the future.
- If future upgrades are anticipated (e.g., upgrading from a non-intelligent unit to an intelligent unit) proactively run data lines during the original installation of the non-intelligent unit to prevent having to run data lines during the upgrade.
- Consider multiple cord set designs which only require one pedestal mount. In addition, a station may be placed between two parking spaces to allow greater flexibility in parking.
- Locate the charging station as close to the existing electric panel as possible.
- Plan to run conduit on the outside of the wall cavity to minimize any fishing of the wiring through the walls.
- Install a wall mount unit to minimize any concrete work. When trenching is necessary, try to utilize landscaping areas to avoid cutting hard surfaces.

To decrease the amount of time it takes from the start of an installation to the finish, property owners should consider the following.

- Be clear on the location of the charging station from the very beginning and do not change the location.
- Know whether a charging station with Point of Sale capabilities will be needed so that the correct unit type can be installed.
- Have the installer apply for the permit at the time the assessment is complete since it may take anywhere from a couple of days to a few weeks receive the permit.
- Ensure the installer has a valid business license in the jurisdictions where the work is being performed prior to the assessment.
- Ensure that installer has the inventory on hand for the install.
- Request that the inspector perform the inspection on the same day as the install (if needed).
- Be available to provide access to the facility where the installation is to occur or the electrical rooms which house the associated panels.

DC Level 2 Fast Chargers

DC Level 2 fast chargers can charge a typical electric vehicle 80% in approximately 30 minutes or less. These stations usually require three phase service at either 208 or 480 volts. Because of the type of power needed to operate a DC fast charger, few locations currently have infrastructure that is appropriately sized to support the operation of such a unit. Installation costs for a DC fast charger are primarily driven by the need for electric service upgrades, larger conductors, additional transformers and larger circuit breakers. The need for trenching, concrete work and signage also adds additional costs.

There is no available data on the cost to install DC Fast Chargers in the North Carolina region, although costs will vary greatly depending on the specific site just like any commercial installation. Based on the sufficiency of the site's existing infrastructure and electric service as well as the size of the DC Fast Charger to be installed, the installation costs could be more than \$75,000 for a 200 kW unit used to charge electric buses, to a little as \$15,000 for a smaller 40 kW unit used to charge passenger vehicles at a rest stop.

Because installation costs of DC Fast Chargers vary so greatly and there is so little experience in installation of these units, there is no regional average cost to offer at this time.

Charging Infrastructure Selection Guide

There are many quality resources related to the actual installation process for charging infrastructure; however the working group noted there was little to guide host sites or vehicle owners in the decision process of what type of charging station to install. This includes which power level (AC Level 1, AC Level 2, DC Fast Charging) is best suited to the application but also how many and what features should be considered. The working group developed the following "flow charts" to guide this decision making process for the following scenarios:

- Residential
- Commercial retail site owners
- Workplace charging for employees

EVSE Decision Tree for Residential Site Owner

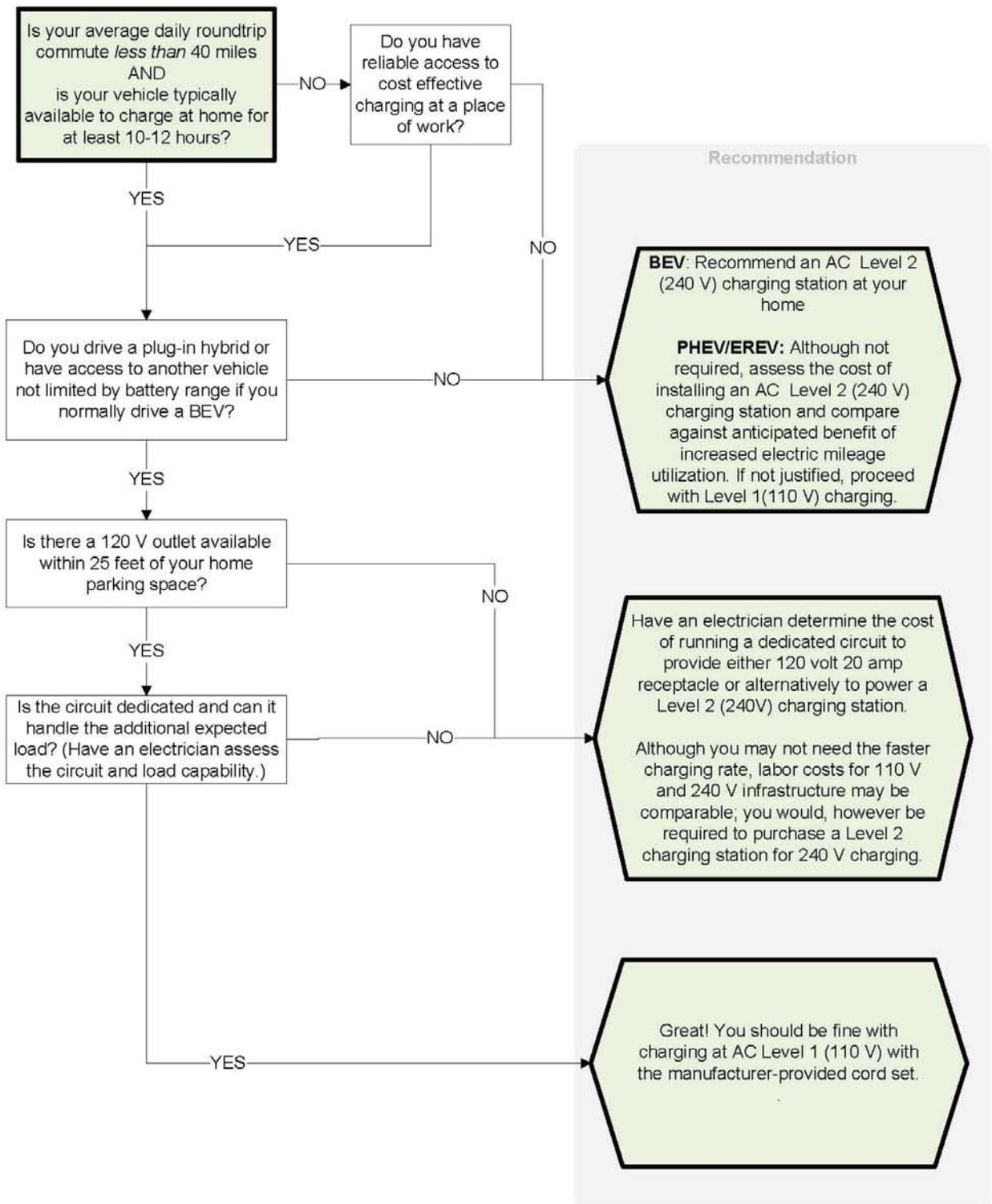
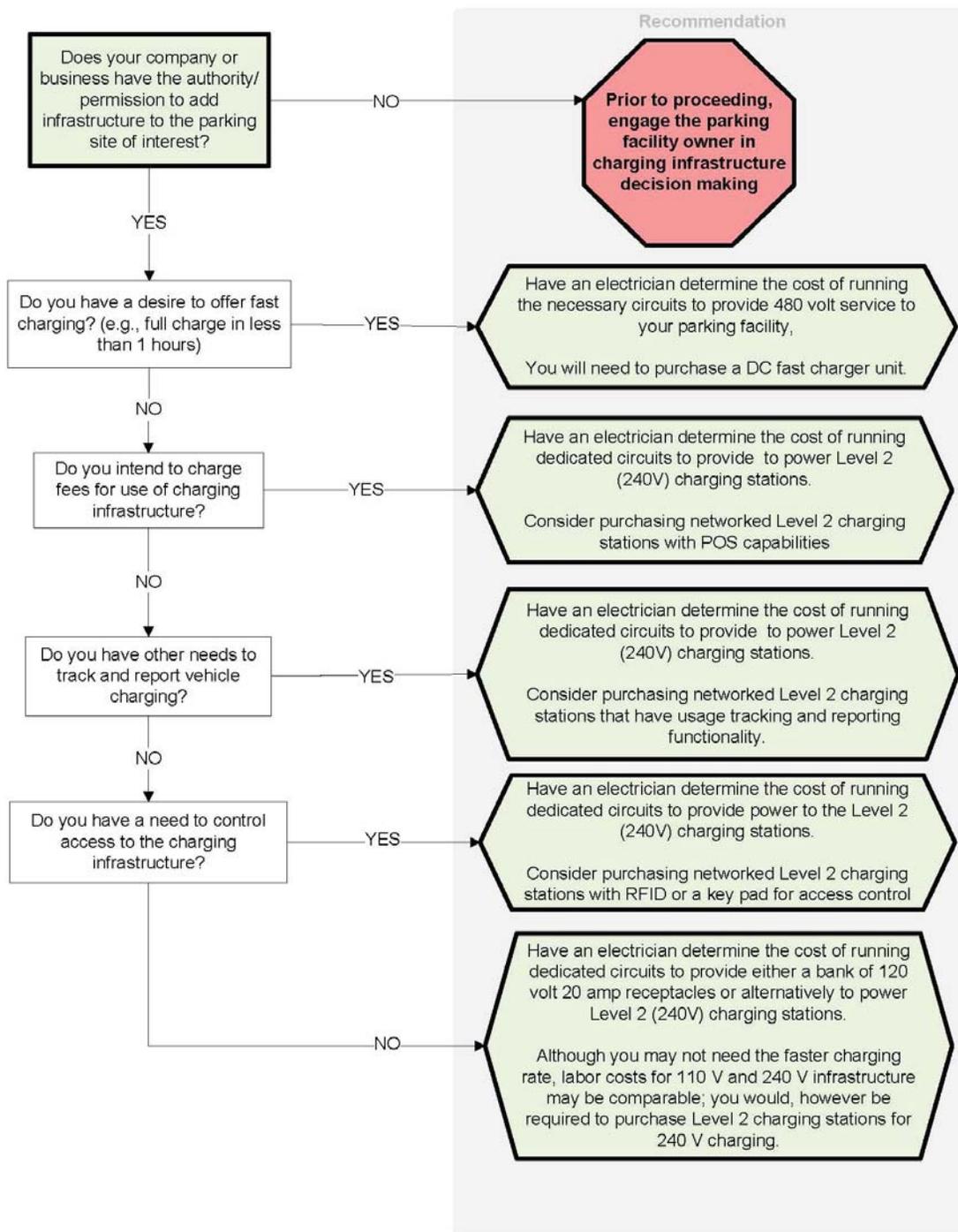


Figure 19 Decision Tree for Residential Site Owner

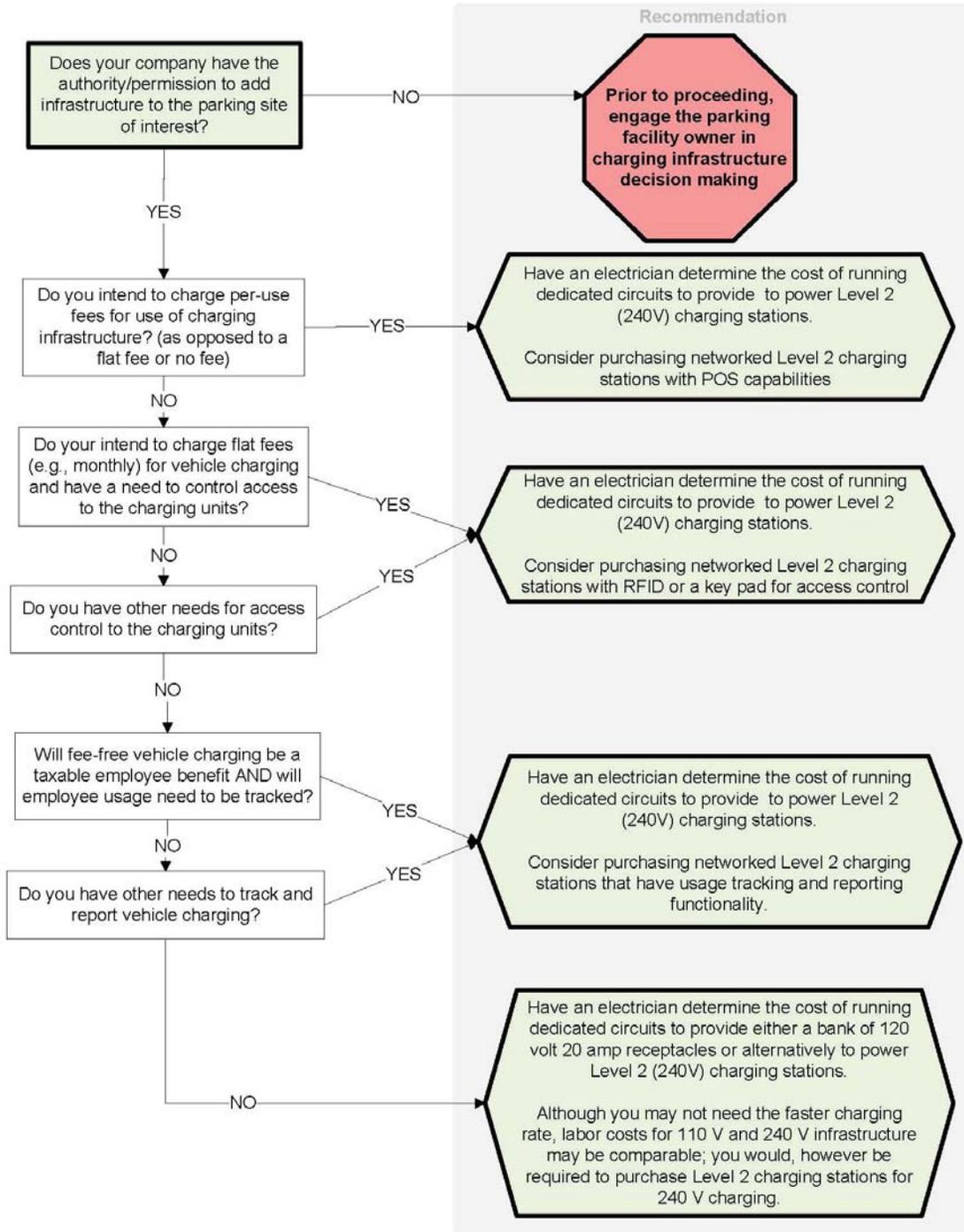
EVSE Decision Tree for Commercial/Retail Site Owner



NOTE: This tool assumes that the site owner has performed any appropriate research need to determine that adding vehicle charging is an appropriate investment for his site

Figure 20 Decision Tree for Commercial/Retail Site Owner

EVSE Decision Tree for Workplace Charging



NOTE: This tool assumes that the site owner has performed any appropriate research need to determine that adding vehicle charging is an appropriate

Figure 21 Decision Tree for Workplace Charging by Employees

Existing Charging Infrastructure Locations and Programs

Charging Infrastructure Survey

North Carolina is one of the top ten states in the country with respect to the number of electric vehicle charging stations deployed today. It has been able to achieve this level despite not being a part of the large national deployment programs thanks to the hard work and dedication of organizations within the state and financial assistance from local, state, and the federal government. Because of the “ground up” approach of the infrastructure build out by many entities and the constant additions, it is very difficult to provide a truly accurate count of stations at any point in time. To ascertain the best count, the working group queried the Department of Energy’s Alternative Fuels Data Center (AFDC) station database as well as crosschecking against statewide and community level surveys. The table below provides the results for non-residential charging stations, both private and public in North Carolina as of 11/12/2012. We believe this number to be undercounting the actual number of stations as many stations may not have been uploaded yet into the AFDC database and may have been overlooked by the working group.

Table 8. Non-Residential Electric Vehicle Charging Sites and Stations in North Carolina					
	Sites	AC Level 1	AC Level 1	DC Fast Charging	Total Charging Ports/Cords
Private	68	37	137	2	176
Public	160	68	287	0	355
Total	228	105	424	2	531

Note that private stations listed in the table above may include fleet stations used by fleet entities, workplace charging reserved for employees, multifamily dwelling units reserved for tenants, retail stations reserved for paying customers (e.g., a hotel) or charging stations at dealerships for their private use. Due to the difficulty in discerning these different applications from the AFDC database and community surveys, the team is not able to accurately separate out the numbers into more specific categories. Public infrastructure is self explanatory in that the station may be owned and operated by a third party for the use and benefit of vehicles owned by the public. A significant number of the listed public stations are owned by Nissan dealers as part of their effort to support the marketplace for BEVs.

Figure 22 depicts the site locations for public and private charging infrastructure across the state of North Carolina. The size of the dots is relative to the number of stations in a specific area.

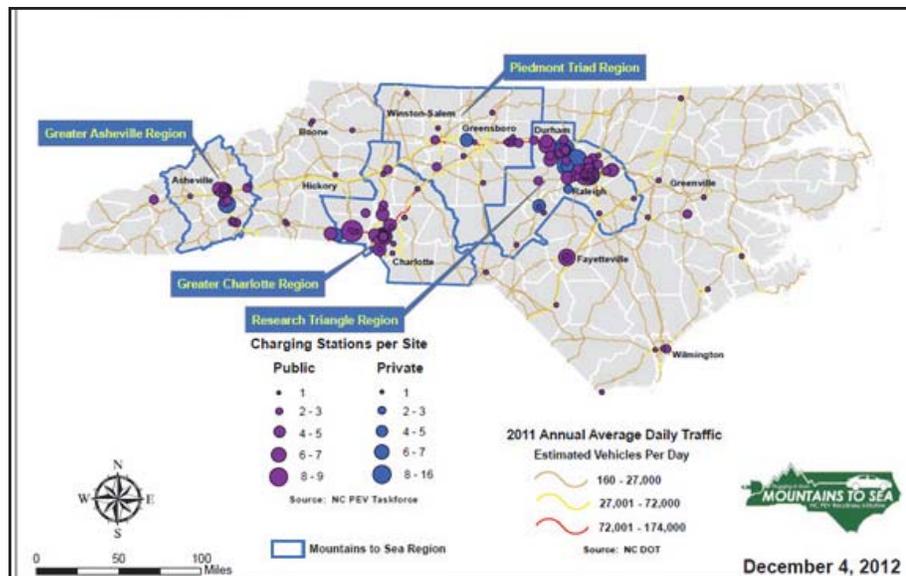


Figure 22 Map of Public and Private Charging Stations in NC

Another informative way to look at public charging stations is to compare the access to public charging against the current PEV adoption densities per county. This style of map can help to identify where the level of public infrastructure is on par with the level of adoption and where it is lacking.

Figure 23 highlights that some regions with high PEV adoption such as Charlotte, the Triangle, and Asheville have a good number of public charging stations, while others like the Cape Fear coastal region and the Triad might not be keeping up with vehicle adoption. It also highlights significant gaps in between major metropolitan regions and in rural areas.

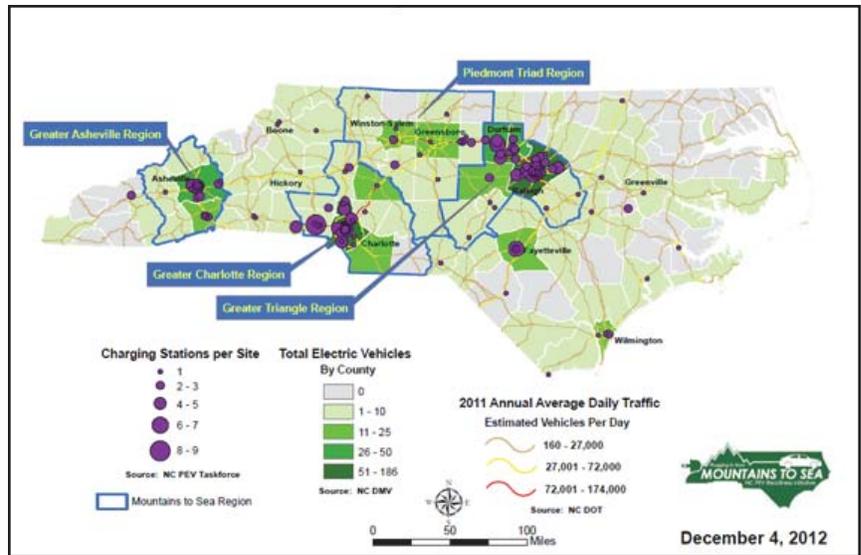


Figure 23 Map of Existing Private Charging Locations in NC (as of 8/20/12)

Residential charging station numbers and types are not reported or captured in a way to provide a full and accurate count. Although the investor owned utilities operating in the state of NC are participating in a voluntary notification system set up by some of the automakers, the information provided is not complete nor is it comprehensive enough to provide an accurate statewide count. It can be assumed however that for every vehicle registered in the state, there is a dedicated charging solution at the residence.

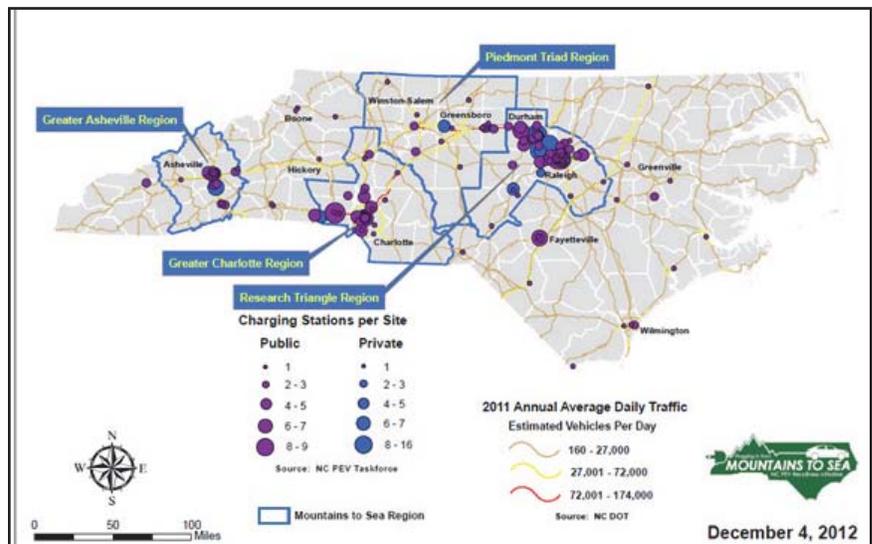


Figure 24 Map of Existing Public Charging Locations and PEV Adoption Densities in NC

The NC PEV Task Force Vehicle Working Group determined in August of 2012 through a DMV query that there were 719 high speed, plug-in electric vehicles registered in NC. So it can be inferred that there are approximately 719 dedicated residential or possible fleet charging stations to support these vehicles. What is not known is whether these stations are simply an AC Level 1, 120 volt outlet in the home or an AC Level 2 dedicated charging station. Since residential stations, as well as most private fleet stations, are not likely to be listed in the AFDC database, the total count of all types of charging stations to support the market in NC was likely greater than 1,250 as of August 2012.

Charging Infrastructure Deployment Programs

As mentioned previously, several entities within the state have been instrumental in supporting the deployment of charging infrastructure over the past few years to support the adoption of PEVs. The following is a summary of just a few of the larger projects and is not meant to be a comprehensive list.

- Carolinas Blue Sky Green Jobs Initiative: Through a DOE grant secured by Triangle Clean Cities Coalition and managed by Advanced Energy, 24 AC Level-2 charging stations were installed across 3 unique workplace locations throughout the Research Triangle Park area.
- NC State Energy Office SepAltFuels Grant: Advanced Energy also secured and managed a grant supporting the deployment of 12 AC Level 2 public charging stations in the Asheville area
- Plugged-in Project: Progress Energy Carolinas, under a DOE Smart Grid grant, helped deploy 150 residential and over 40 public access charging stations with utility customers throughout the Carolinas in 2012. Information gathered from the deployment and through data loggers in the stations will assist the utility in preparing the grid for future widespread adoption of plug-in vehicles.
- Charge Carolinas! Project: Duke Energy Carolinas, under a DOE Smart Grid grant, helped deploy 150 residential smart charging stations with utility customers throughout the Carolinas. Information gathered from the deployment and through data loggers in the stations will assist the utility in preparing the grid for future widespread adoption of plug-in vehicles.

Charging Infrastructure Incentives

A federal tax credit under section 30C that previously provided a significant credit of 30 percent of the installation value for residential and commercial electric vehicle charging infrastructure installation expired at the end of 2011. Although incentives exist at the state level for biofuel refueling infrastructure, there is no current financial incentive for electric vehicle charging infrastructure. At the time of this report, both the Progress Energy Carolinas and Duke Energy Carolinas programs that covered the cost of stations included as part of their load research projects are at capacity and closed to new participants. A more detailed discussion of incentives is covered in the related Statewide Roadmap section.

Charging Infrastructure Locating Tools

As previously mentioned, the Alternative Fuels Data Center database is considered the best national clearinghouse to find public, and to a lesser extent private, charging station locations. All commercial entities that deploy charging infrastructure for public or for private use are highly encouraged to visit the website and log their station location and data. The website also provides a locator mapping tool for drivers and additional resources, although there are many other third-party applications that drivers can also utilize on a smart phone or through their vehicle interface. Most third-parties seek to populate their own database through a variety of means, although the DOE's website is almost always one of those key sources.

Future Charging Infrastructure Needs and Estimates

For help with better understanding the needs of a more fully developed plug-in electric vehicle market, the infrastructure working group consulted with the Electric Power Research Institute (EPRI). The research organization has been working on modeling to predict not only the potential market adoption rate of plug-in vehicles but also the necessary ratio of charging infrastructure to provide adequate charging access. EPRI's national modeling on the ratio of charging stations to vehicles was then applied to the state specific adoption rate of plug-in vehicles through 2030 to provide a rough estimate of the minimum quantity of residential, workplace, and public infrastructure to support the projected vehicle market.

Methodology

EPRI's modeling on workplace and public charging was based on real world driving pattern data from non-plug in vehicles and included several scenarios including 1) vehicles charging at work and public whenever they have access and remaining in the spot even after charged, 2) vehicle only charging if it provides additional electric miles beyond what is provided by residential charging, and 3) a shared model in which vehicles are optimally rotated through a charging station whenever one is complete. For the purpose of this analysis, the team focused on scenario #2 to provide a middle of the road ratio for the necessary charging infrastructure that would provide value to PEVs beyond residential charging.

The result of charging scenario #2 is provided in Figure 25. Note that the results are expressed in charging units per vehicle in the marketplace. The x axis provides different categories including a BEV with a range of 100 miles, a plug-in hybrid with a 40 mile range, and a plug-in hybrid with only 10 miles of range. For each vehicle category, a ratio was calculated for both workplace and commercial (aka public) charging locations across all vehicle classes. Finally, within each estimate the ratio is further defined as either AC Level 1 or AC Level 2 depending on the charging level necessary to provide additional electric miles in the likely vehicle dwell times.

In general, a PHEV with a small battery is able to take greater advantage of workplace and public charging to increase its electric mile utilization much more than a BEV100, since the latter should be able to make most of its trips with only home or fleet depot charging. If not, one might question if a BEV is the best application for a commuting pattern that is consistently outside of its range. Note that this analysis is only focused on charging infrastructure that provides a utilization benefit to the driver, so it does not reflect the psychological benefit of public charging access for BEV drivers. It also highly weights the fact that plug-in hybrid vehicles can achieve greater electric mile utilization through public and workplace charging, and thus the ratio of charging infrastructure per PHEV is much greater than a BEV. This relationship may be counterintuitive to some who believe that public charging access is actually only required and driven by pure electric vehicles and their defined battery powered range. This analysis highlights that while public charging provides a vital security service for a BEV in those rare times the battery range is tested, it also provides a valuable service to plug-in hybrids (PHEV and EREV) as well.

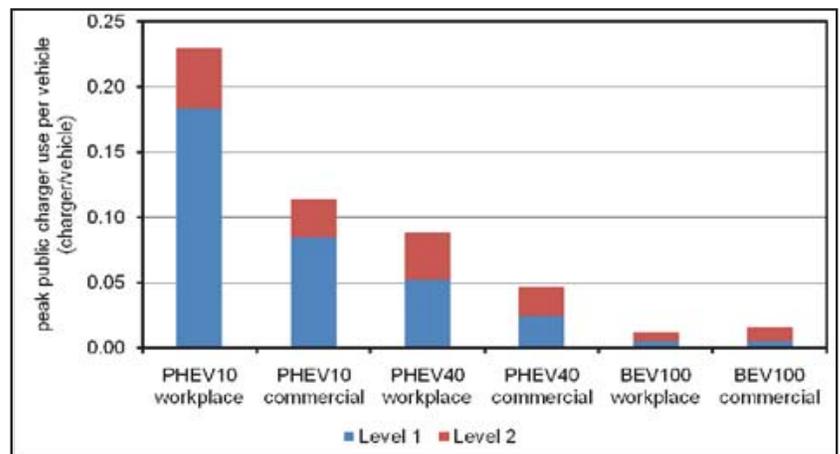


Figure 25 Ratio of Workplace and Public AC Charging Stations to PEVs
Source: EPRI

EPRI also conducted a similar analysis examining DC Fast Charging needs and benefits to serve only the BEV market. Figure 26 displays the ratio results of the number of DC Level 2 fast chargers per 1,000 battery electric vehicles. While such a charger may be the default solution for unique situations such as a city apartment resident, it is more likely to be used in rare times when the battery range is tested for long or unplanned trips. The analysis included two alternative charging scenarios: 1) the BEV can utilize previously modeled AC Level 2 workplace and public charging stations and 2) the BEV would only utilize home charging outside of the occasional DC Fast Charge. There were also three vehicle scenarios: 1) a BEV owner would make any proposed trip regardless of the number of DC Fast Charges required, 2) a BEV owner would only make trips that require up to 1 DC Fast Charge due to practical time constraints, and 3) incorporating the possibility of BEV owners also having another non-BEV option for longer trips. The

results show that when additional non-home charging opportunities and vehicle choices are available, the number of necessary DC Fast Charging stations per BEV decreases. Overall the model highlights that a relatively small number of DC Fast Chargers, 1 to 5 per 1,000 BEVs, is sufficient to support the occasional quick refueling needs of battery electric vehicles.

The ratios of all types of charging stations are then to be applied against an estimate of the number of plug-in vehicles to be in a region or the state at a certain year. This estimate is derived from a different EPRI model and is explained in more detail in the NC PEV Task Force Vehicle Working Group paper.

Although three scenarios of adoption are projected, the team utilized only the middle scenario to provide a projection of future charging infrastructure requirements. In order to match up against the ratio analysis of different charging locations, the team also made an assumption of an even breakdown of BEV100, PHEV40, and PHEV10 vehicle classes making up the total count of PEVs (Figure 26).

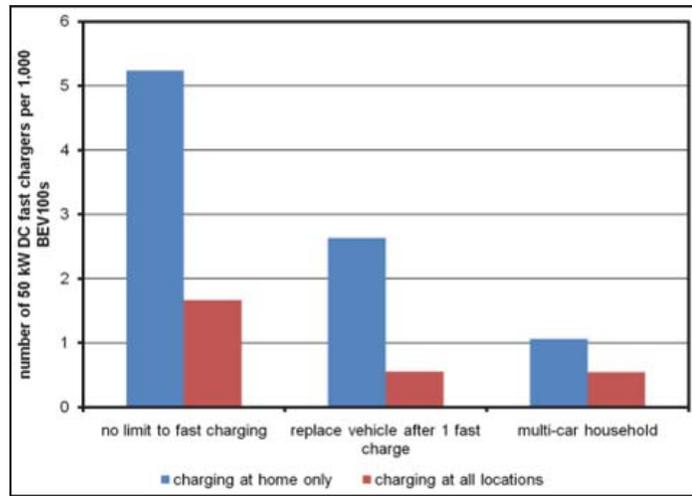


Figure 26 Ratio of DC Level 2 Fast Chargers to BEVs
Source: EPRI

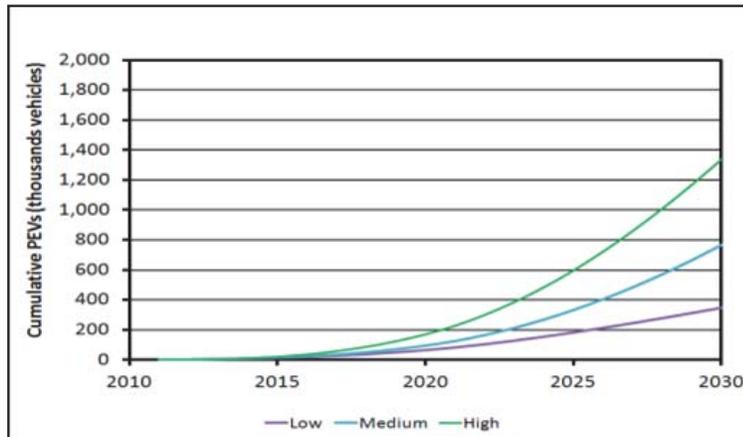


Figure 27 Projected Cumulative Plug-in Vehicle Adoption in NC
Source: EPRI

For private residential and fleet stations, the team assumed that every PEV also had a dedicated charging station at home or a fleet depot. PHEV10 were assigned a Level 1 outlet, BEVs were assigned an AC Level 2 station, while PHEV40s were split evenly between the two. These assignments were made to simplify the analysis and are based at a high level on the charging rate need versus the likely battery charge required for each vehicle class. Additional real world data is required to better gauge the customer desires and vehicle requirements to determine how the actual charging rate preference will play out.

It should also be emphasized that the preceding public and workplace ratio analysis assumed three basic classes of PEVs with battery sizes ranging from 10 to 100 miles of range. Battery technology is expected to make significant gains in terms of cost and energy density over the next two decades, so it is possible that the average range of any class of plug-in vehicles could be much more than the current generation of vehicles. As an example, the Tesla Model “S” currently offers vehicles with an EPA rated range of up to 265 miles albeit at a price premium. If such ranges become affordable and common, then the desired ratio of public and workplace charging stations that would provide value (added range) above home charging would be lower.

Results

Figure 28 depicts the estimated number of workplace charging stations necessary to support the predicted PEV marketplace (EPRI medium scenario) through 2030. Note that the results indicate a high percentage of stations can be Level 1 to satisfy workplace charging needs. This is driven by the fact that many of the vehicles charging at a workplace are parked for a long period – normally 7-9 hours. The long dwell periods provide plenty of time to supply the necessary charge to replenish most commutes under 30 miles even at the lower power of Level 1. In practical terms however, the actual installation cost is often very comparable between a new Level 1 and Level 2 charging station and a host may opt for the higher power level provided they don’t mind spending more for the EVSE itself and incremental demand charges are not a concern or can be managed. It should just be noted that it may not provide significantly greater value in terms of electric mile utilization for the vehicles using the stations. Impact to the premise’s electricity demand charges may also play a role in selecting a lower power level.

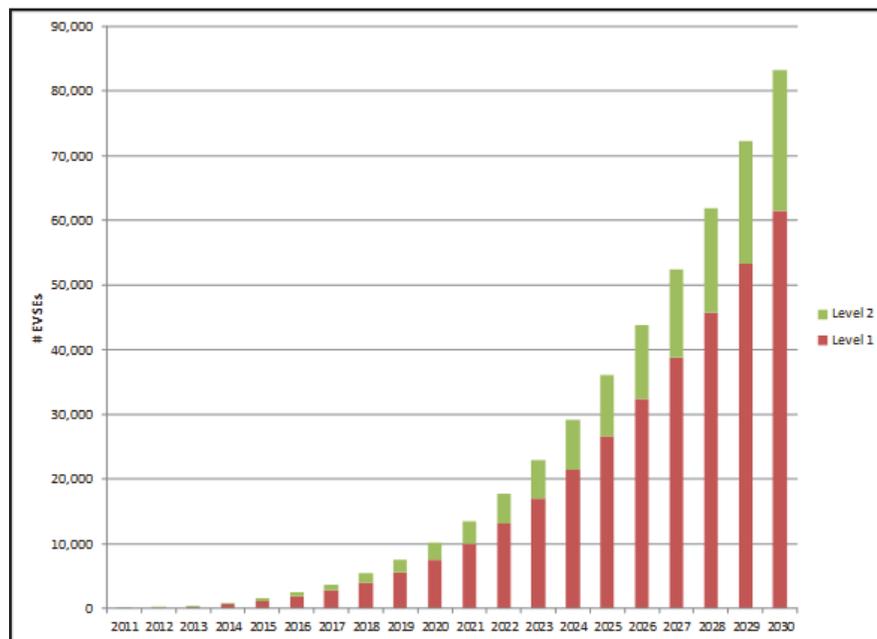


Figure 28 Estimated Number of Workplace Charging Stations in NC Through 2030
Source: EPRI

Figure 29 depicts the estimated number of commercial (public) AC charging stations necessary to support the estimated PEV marketplace (EPRI medium scenario) through 2030 in NC. As with the workplace charging infrastructure needs, the results indicate a large percentage of stations could be AC Level 1 as opposed to AC Level 2. However unlike the workplace application, the working group did not feel comfortable in suggesting that Level 1 should be used to such a great extent in the public space.

The intention in most applications would often be to drive throughput through stations via faster charging and turnaround times. In addition, the installation cost would likely be very similar between AC

Level 1 and AC Level 2 (outside of the equipment itself). As such, the working group strongly encourages that hosts and planners consider targeting a higher level AC Level 2 power (208/240 volt, ~40 amp circuit) whenever feasible in the public use application. Some specific applications for Level 1 may still make sense where dwell times are longer such as airport or hotel parking.

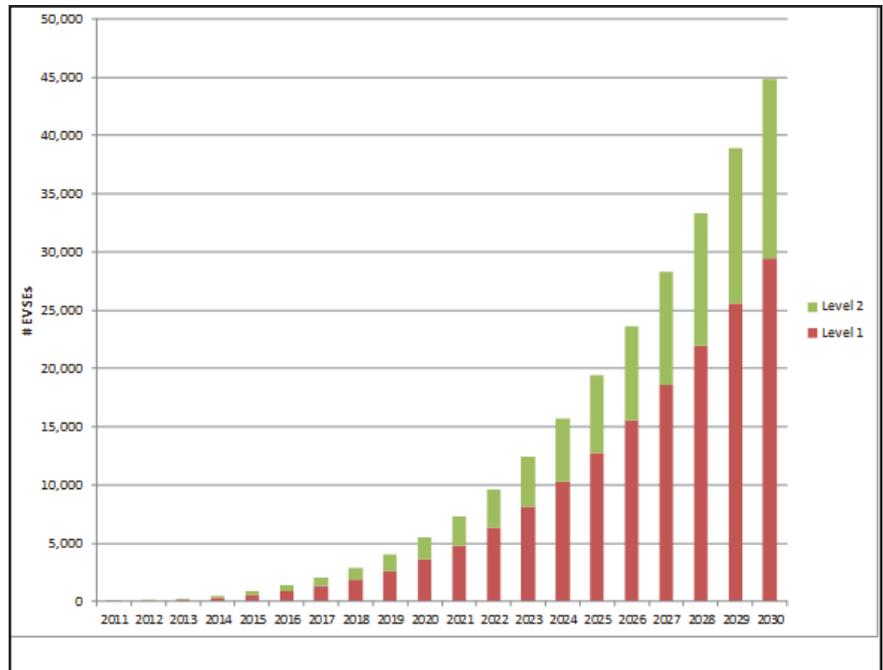


Figure 29 Estimated Number of Public AC Charging Stations in NC Through 2030
Source: EPRI

Figure 30 depicts the estimated number of DC Fast Charging public stations necessary to support the estimated BEV marketplace (EPRI medium scenario) through 2030 in NC. Note that this analysis is only based on the number of BEVs in the marketplace as opposed to all PEVs as was used in the previous graphs. This is because there are no stated automaker plans for PHEV/EREVs that incorporate a DC Level 2 port, although that could change in the future. The team opted to focus only on BEVs due to the uncertainty of future plug-in hybrid models incorporating a DC fast charging port and the higher cost/business case justification necessary to warrant a more expensive DC fast charging installation. And

as mentioned in the methodology, there are multiple curves due to the multiple scenarios outlined by EPRI. The correct estimate is not necessary any one of these lines, but is likely somewhere in between

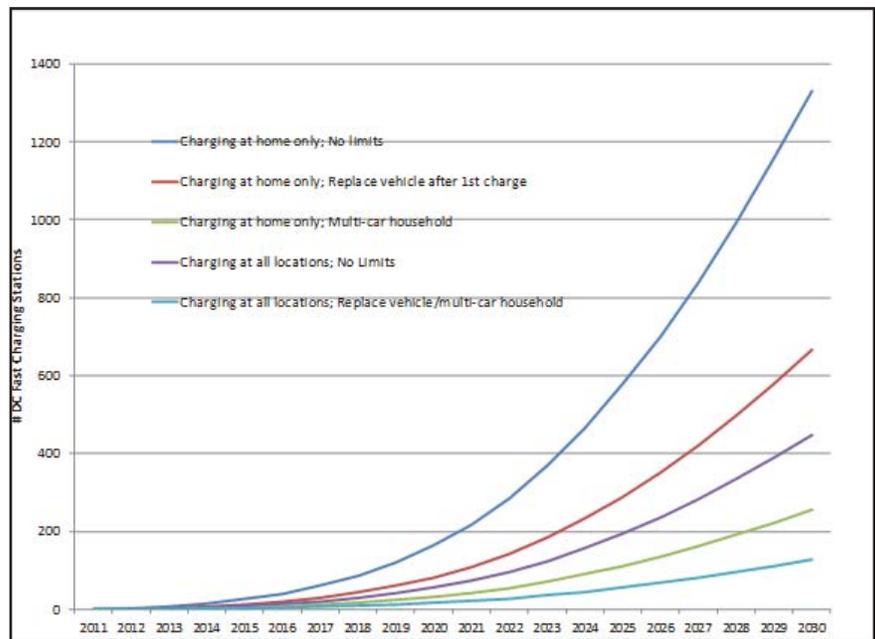


Figure 30 Estimated Number of Private Residential/Fleet Charging Stations in NC Through 2030

Figure 31 depicts the estimated number of dedicated “residential” charging stations (in thousands) necessary to support the estimated PEV marketplace (EPRI medium scenario) through 2030 in NC. As outlined in the methodology section, we assume that every registered vehicle has a dedicated charging station at its “home” location and the split is even between AC Level 1 and AC Level 2.

Although not individually broken out, depot charging for fleet charging is also assumed to be part of this total count.

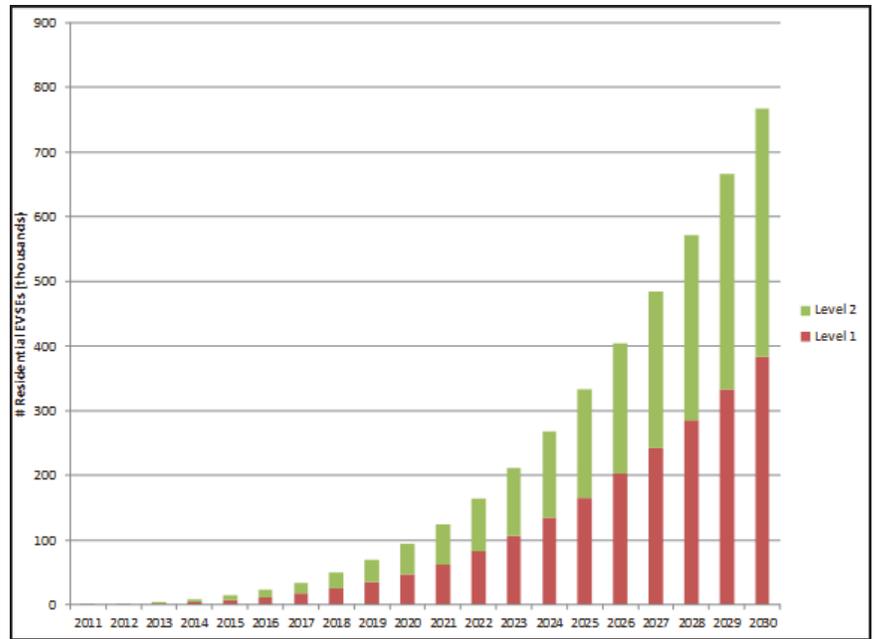


Figure 31 Estimated Number of DC Level 2 Fast Charging Stations in NC Through 2030

Mapping and Planning for Public Charging Infrastructure

Public Charging Use Cases

In order to optimally plan and forecast public charging infrastructure needs and locations, we must first consider how public charging might be used by a PEV driver:

1. **BEV Long Trip:** Occasionally a BEV owner may plan to travel to a destination beyond the normal battery range and so a stop to charge along the way is required.
2. **BEV Overextended:** Occasionally a BEV owner may simply run too many errands, get stuck in traffic, or have an unplanned trip which necessitates a charge to return home safely.
3. **BEV Safety Net:** In this case, the existence of the public stations actually enables BEV adoption despite the fact they might rarely, if ever, be used for the first two cases. TEPCO electric utility in Japan has previously documented how the addition of public infrastructure helps increase range confidence and driving patterns despite minimal actual station use.
4. **PHEV/EREV Utilization Increase:** Although a plug-in hybrid can run on gasoline once the battery is depleted, the owner will still desire to run on electricity whenever possible because it is cheaper, cleaner, and domestically produced. With the increased availability of 10-20 electric mile range PHEVs in the coming years, this market may seek to recharge often in public if cost effective.
5. **“Because it’s There”:** In some cases, all types of PEVs will simply plug in because it’s there and it feels good, despite the fact they did not add any additional electric miles to what they would have already achieved. The one benefit in this case might be in the education of potential PEV adopters that charging infrastructure does exist and can be easily used.

The first four cases provide value driven benefits to support PEV drivers in their everyday commutes and the overall adoption of the technology. The last scenario will also occur and care should be taken to avoid encouraging this type of use especially when public funds are utilized as it ties up stations that could be utilized by others. Private retailers that host charging infrastructure may have a completely different view since their goal is simply to attract a certain type of customer regardless of whether charging provided additional electric miles.

Public Location Considerations

When selecting a location for the installation of a charging station for use by the public, it’s important to consider several factors to ensure that the unit is highly utilized.

1. **PEV Adoption:** Obviously regions of high PEV adoption, usually high density metropolitan areas, will provide a larger customer base to make use of public charging options.
2. **Transit Corridors:** Locating a station near or along major roads and high traffic corridors will allow for easy access to those in need of a charge. Local Metropolitan planning organizations are often a good source of specific traffic volume information.
3. **Local Activities:** Charging rates for AC Level 2 stations are typically in the range of 10-20 added miles per hour of charge. Assuming someone is using the station to actually extend their electric miles usage, then that user will want something to do on site for at least 1-2 hours.
4. **Host Site Engagement:** Sometimes host sites own and operate the charging equipment while other times they are simply a host to a third party. In any case, a host site must be informed, engaged, and committed to supporting the use of the charging station.
5. **Geographic Spread:** Locations that would provide charging access in an area that is currently underserved would rank more highly than an area with several stations nearby.
6. **Visibility:** Public locations will benefit greatly if they are placed in highly visible locations as opposed to around the back of a store. However, it should also be noted that highly visible locations often do not have low cost access to electricity service and can irritate other customers if reserved but underutilized by PEVs.

7. **Power Availability:** Power access can vary greatly depending on the general type of host site as well as the specific preferred location on the grounds of the site. In some cases, power can easily be connected to a station from a nearby power panel behind a customer's meter, or through new service provided by the utility. In other cases, the long runs or trenching/paving requirements may result in the location being cost-prohibitive.

Below is a suggested list of potential public charging locations that may rank highly in some or all of the criteria noted above, although each specific site will still need to be reviewed against all aspects.

- County Library (libraries are already well spaced across a region)
- Shopping Malls
- Hotels
- Restaurants (usually not fast food)
- Movie Theaters
- Public Parking Decks/Lots
- Visitor Centers
- Universities/Community Colleges
- Grocery Stores
- Destination Locations (e.g. a zoo, aquarium, etc.)

Gas stations are often mentioned as possible locations based on our existing mindset of where to refuel, but in many cases such a location would not be suitable for a stay of an hour or two (unless a DC Fast Charger is under consideration).

Public Charging Infrastructure Coverage

The Infrastructure Working Group collaborated with the Electric Power Research Institute to run through a hypothetical planning exercise in mapping the minimum public station coverage necessary to provide public charging support. This is not linked in any way to the projected number of public stations necessary to support the estimated vehicle adoption through 2030 in NC as outlined earlier. Rather it is a visual illustration and a rough estimation of the critical network coverage necessary to support the early PEV adoption across the state. It does not account for the growing demand over time as the market grows and assumes ideal placement and availability. Furthermore, this critical network is designed more to support regional travel and provide emergency charging when necessary. It is not necessarily designed to accommodate intercity BEV travel beyond the normal vehicle range, although some of the stations may accommodate such use. While this critical network number should not be interpreted as an end goal, it does provide a reference as to how many stations are needed to ensure adequate initial coverage for a vast majority of the state.

Let's first review the current locations of public stations as listed in the DOE's Alternative Fuels Data Center database. These sites have been overlaid across NC utilizing GIS mapping techniques and the size of the dots are representative of the number of stations. The map also provides additional information on the traffic density of major highways throughout the state. Note this figure is a slightly different format since it was developed in a separate GIS system and only depicts stations listed in the AFDC.



Figure 32 Example of Public Charging Stations in North Carolina

As depicted in Figure 33, many of the larger metropolitan areas in the state already have some basic coverage with public stations. As such, the following analysis will not call for additional stations in metropolitan regions with a population larger than 100,000 (2000 census) with the assumption that existing efforts or private retailers will provide some basic coverage. As a starting point for new stations, the analysis will look to add one charging location at every town in NC with a population of at least 2,000 (but less than 100,000). This results in approximately 252 potential charging station locations across the state. Some of those towns are clustered within a few miles of each other and can be eliminated to reduce overlap of coverage, bring the total new town installations below 200. Placing charging stations at these town locations covers a large portion of the populated region of the state, although it still leaves some transit corridors and remote regions without any charging solutions for more than 10 miles. A few dozen additional “safety” charging locations are added to these gaps to ensure greater geographic and population coverage of the state. After the elimination of the cluster towns and the addition of gap “safety” stations, the total tally of a desired critical charging station network for the state is approximately 244 locations. The figure below depicts the locations of the network stations along with a 10 mile radius around each station is also depicted/indicated by the blue hash circles. Anchor locations are differentiated as being top priority sites due their location with respect to major transit corridors and cities.

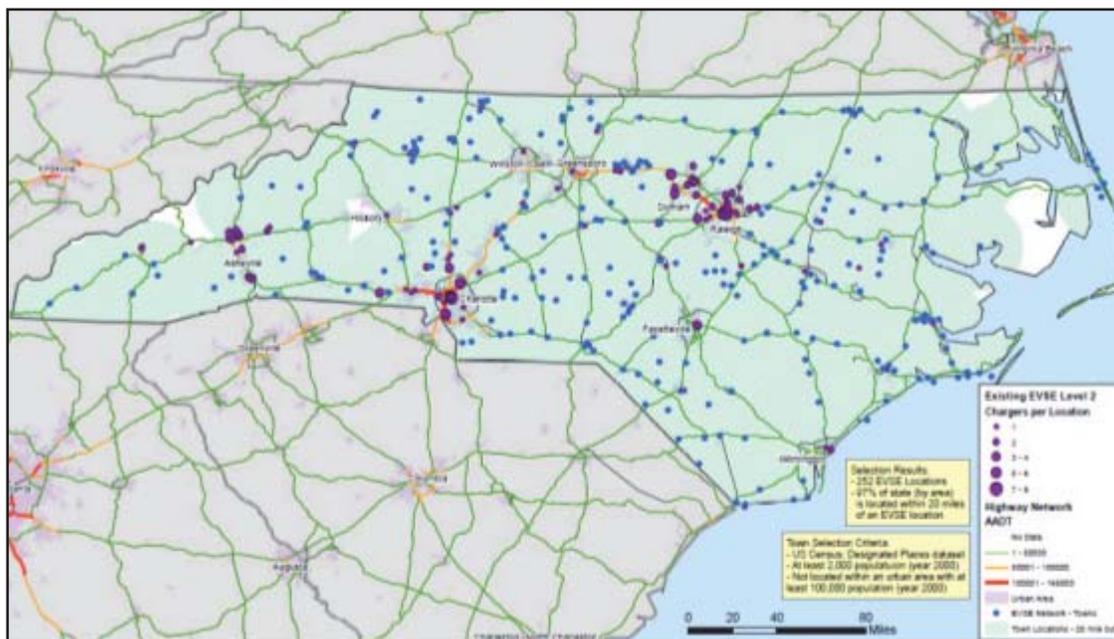


Figure 33 Mapping of Additional “Town” Public Charging Locations in NC
Source: EPRI

Conclusions and Recommendations

North Carolina is well positioned as an early adopter of plug-in electric vehicles and related charging infrastructure. At the time of the report, over 355 public and 176 private commercial charging points existed at 228 locations throughout the state. Many cities, counties, businesses, and non-profits are recognizing the energy security, environmental, and fuel cost benefits associated with electrifying transportation. Although there is a good start in the deployment of charging infrastructure to support plug-in vehicles, there is still more work to do to expand charging access, reduce cost and complexity, and develop viable business models.

The NC PEV Task Force Infrastructure Working Group focused on researching and providing the best available information and resources in this paper to support the future build out of charging infrastructure however that may occur. If there is a second phase of implementation supported by a funding mechanism and coordinated at a state level, then the team would recommend continuing the group effort and a targeted approach of identifying ideal locations based on the criteria and maps contained in this report. This approach would help ensure optimum coverage with minimal overlap and a relatively uniform approach. Conversely, the network may simply continue to build out from the “ground up” through the individual efforts of local government and businesses. Although this approach will not always provide adequate coverage and may result in some redundant locations, it is still a viable pathway to continue to support to the emerging market. In this case, the team should focus on publicizing the information contained in this report to support local entities that plan to install charging infrastructure and attempt to collaborate and plan amongst entities at the regional level, such as metropolitan and transit planning organizations.

POLICIES, CODES AND STANDARDS



5

Authored by:

NC PEV Taskforce Policies, Codes and Standards Working Group

Led by:

Centralina Council of Governments/Centralina Clean Fuels Coalition

POLICIES, CODES AND STANDARDS

Introduction to Policies, Codes and Standards

The electric vehicle industry has seen significant growth over the past decade that is being advanced by a seemingly endless number of innovations. In December 2012 alone, researchers have changed the way we think about PEV charging by demonstrating that PEVs can be powered with electricity transmitted from the road to steel belts in tires. In this same month, Toyota announced that it is pursuing magnesium-ion battery technology as a cheaper, more energy-dense alternative to lithium-ion batteries. As with any growth industry; codes, regulations and standards must be developed to ensure public safety and allow for accessible use of emerging technologies.

This chapter reviews current policies, codes and standards surrounding PEVs and charging infrastructure while recommending changes that can remove barriers to adoption, deployment and installation of PEVs and associated infrastructure. This section also suggests certain codes and policies that can encourage the use of PEVs within North Carolina's communities.

Existing Policy, Codes and Standards for PEVs

National Resources

The Education and Outreach Working Group reviewed national examples of education and outreach initiatives for PEVs. Some key examples are listed below.

The following list cites existing local resources and examples of policies, codes and standards that are referenced throughout this chapter:

- Carnegie Paper: Policy Priorities for Advancing the U.S. Electric Vehicle Market
- Ecotality: Lessons Learned – The EV Project White Paper Syllabus
- EV Charging for Persons with Disabilities
- International Energy Association: EV City Casebook
- Plug-in Ready Michigan: An Electric Vehicle Preparedness Plan
- Plug-In Electric Vehicle Readiness Plan for the State of Washington
- Southeast Regional EV Readiness Notebook (1st Edition)
- California PEV Collaborative: Streamlining the Permitting and Inspection Process for Plug-in Electric Vehicle Home Charger Installations
- DOJ 2010 ADA Standards for Accessible Design
- ANSI Standard A117.1-2009 "Accessible and Usable Buildings and Facilities"
- MIT Technology Review
- GM's Plug-in Electric Vehicle (PEV) Directional Policy Recommendations
- U.S. Petroleum Use: Energy Information Administration. 2011. Annual Energy Review 2010

Local Resources

The following list cites existing local resources and examples of policies, codes and standards that are referenced throughout this chapter:

- Advanced Energy: Charging Station Installation Handbook
- Advanced Energy: Residential Charging Station Installation Handbook for Single- and Multi-Family Homeowners and Renters (Versions 1.0)
- Durham City-County Electric Vehicle and Charging Station Plan
- Town of Midland: Revision to UDO to include requirements for Electric Vehicle Charging Stations

NC PEV Taskforce: Policy, Codes and Standards Working Group

Goals and Objectives

To gather information on codes, regulations, and standards related to electric vehicles, the Project Team held a working group meeting and researched technical reports focused on this topic. The working group meetings and research primarily focused on charging station standards, electric codes, building codes, permitting and education.

Working Group Members

Most members of the NC PEV Taskforce volunteered to be a part of the Policy, Codes and Standards (PCS) Working Group at the launch meeting on October 27, 2011. Several others joined the working group over the course of the successive months of plan input. The final member list is included in the NC PEV Roadmap.

Members of this working group included representatives from educational, governmental, and planning organizations from across the state.

Focus Areas

AMERICAN DISABILITIES ACT (ADA)

Local governments in North Carolina consistently identified addressing the American with Disabilities Act (ADA) as one of the largest barriers to the installation of charging infrastructure. The PCS workgroup made ADA its top priority and worked closely with workgroup members such as the NC Department of Insurance to address the focus area.

SIGNAGE

One of the most obvious examples of a lack in standards, PEV related signage varies among locations in North Carolina regardless of whether owned by local government or private business. The PCS workgroup researched both emerging standards at the federal level while also considering best practices at locations around the state.

Local Example of Importance of Codes

Permitting is an important part of the plug-in electric vehicle adoption process. In the 1990s one major obstacle to the adoption of PEVs was the amount of time it took to install a charging station – almost three months! Customers who purchased a PEV were unable to charge their vehicles at home until they installed their residential charging station, which required a permit. This made adoption of PEVs much less attractive and PEV manufacturers want to avoid dealing with the same situation again. As such, they are targeting communities for early launch that are actively addressing the permitting process as well as related local building codes⁴⁹.

Today, many of the Plug-in Electric Vehicle purchasers will be installing charging stations in their homes. It is important the local governments not only develop streamlined and effective permitting processes, but also that they coordinate with key stakeholders such as electric utilities so that they can monitor the local impact to the grid.

BUILDING CODES

Important for both contractors and ensuring the safety of charging infrastructure, the PCS workgroup engaged a number of local code professionals to determine priorities for updating regulations in this focus area.

PERMITTING

A lengthy and unclear permitting process for the installation of EVSE is proven to be a key barrier to the adoption of PEVs. The PCS workgroup identified local case studies that could be replicated across North Carolina to ensure an expedited permitting with a focus on processes for private business and residential installations.

ZONING CODES & ORDINANCES

There are a number of issues important to local governments when planning for charging infrastructure. The PCS workgroup collected local case-studies and local ordinances that facilitate the installation of publicly available charging infrastructure and support public access.

TECHNICAL TRAINING

Early on, the PCS workgroup noted the importance of coordinating education & outreach efforts to include resources for contractors and inspection groups to ensure a common understanding of emerging codes, regulations and standards.

LEGISLATIVE CONSIDERATIONS

Legislative policies can greatly boost or hinder the adoption of PEVs and charging infrastructure. The PCS workgroup took a close look at legislative policies driving the advancement of PEVs in other states across the country while also considering what types of legislation could work best within North Carolina's political climate.

MODEL PLANS

Perhaps the best resource for understanding emerging codes, regulations and standards are local examples. The PCS workgroup identified a number of model plans in North Carolina that can be referenced by neighboring municipalities as the state prepares for PEVs and charging infrastructure.

Focus Areas for Policy, Codes and Standards

American Disabilities Act (ADA)

As municipalities and businesses install publicly available electric vehicle charging stations, an important design requirement is to ensure accessibility for disabled users. In the United States, the accessibility of public facilities is mandated by the Americans with Disabilities Act (ADA) and is generally governed by three standards:

- The International Building Code (IBC),
- The American National Standards Institute's (ANSI) Standard A117.1 "Accessible and Usable Buildings and Facilities", and
- The US Department of Justice (DOJ) 2010 ADA Standards for Accessible Design

A challenge for public and private entities intending to install charging stations for public use is that the governing codes and standards do not yet specifically address electric vehicle charging stations. Some generic accessibility requirements for public infrastructure or services are easily assessed (for example, reach ranges for operable controls). However, the most common type of public vehicle charging is currently provided by adding charging hardware to an existing parking space. In many cases these new charging spaces are restricted to use by plug-in electric vehicles (PEVs) and as a result the primary

purpose of the space becomes fueling instead of parking. This can create confusion as to which accessibility requirements should apply and how they should be interpreted, and several requirements are simply undefined at this time. There may also be accessibility requirements for parking facilities that are still appropriate to retain.

The codes and standards governing accessibility at a given facility can vary depending on which codes have been adopted by the applicable state or local jurisdiction and by the type of facility. Title II facilities are state or local government facilities, and Title III facilities are public accommodations and commercial facilities. In North Carolina, the local Authority Having Jurisdiction (AHJ) is responsible for enforcement of the applicable requirements⁵⁰:

- Title II facilities must comply with the US DOJ 2010 ADA Standards⁵¹ AND the 2012 NC Building Code⁵², Chapter 11, which references the 2009 ANSI A117.1 Standard.
- Title III facilities must comply with the 2012 NC Building Code, Chapter 11, which references the 2009 ANSI A117.1 Standard.

Please note that charging station installations may also be governed by regulations found in a local zoning ordinance or unified development ordinance. Federal standards generally call for a 1:25 parking ratio of parking places to be reserved for accessible spaces.

Total Charging Spaces	Total Accessible Charging Spaces	Van-Accessible Charging Spaces
1-25	1	1
26-50	2	1
51-75	3	1
76-100	4	1
101-150	5	1
151-200	6	1
201-300	7	2

This section reflects the conclusions reached in conversations with North Carolina city and county officials as well as accessibility code consultants at the North Carolina Department of Insurance (NC DOI), which is responsible for interpretation of North Carolina’s building and related codes. The purpose of this section is to provide local officials and property owners with the best known guidance at this time for providing accessibility of charging stations, as failure to comply with the regulations or to provide a reasonable accommodation can result in legal liability for the charging station owner.

Site owners must keep in mind that the accessibility code does not function in the same manner as most other codes with regard to updates. For example, construction that pre-dates a building code revision is typically “grandfathered” in compliance with the code that was in effect at the time of construction. Instead, as the accessibility code is updated facilities are generally required to upgrade to the current standard. It may be more cost effective to take a proactive approach to charging station accessibility, because retrofits may be significantly more expensive to implement in the future than enhanced new construction in the present.

The requirements and recommendations described herein through support of the PCS workgroup are provided as guidance only – official compliance for any electric vehicle charging station is subject to the code enforcement of the local AHJ, which may be supported by a formal interpretation from the NC DOI. Where available, specific code references are provided.

General Guidelines

The PCS workgroup thoroughly explored a number of items associated with the American with Disabilities Act including accessible routes, availability and site design. A complete guide to these items related to ADA standards can be found within resources provided by Advanced Energy in the Plug-in Electric Vehicle Toolbox, which is part of the Community Planning Guide for Plug-in Electric Vehicles: <http://www.advancedenergy.org/transportation/>.

The information below provides a general overview of how these issues can be approached:

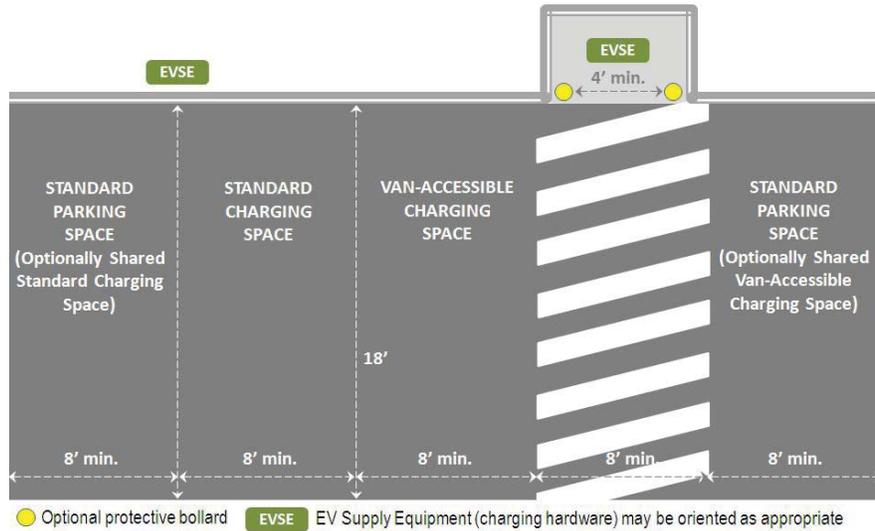


Figure 35 Installation in Parking Lots at Medians or Grade Perimeters

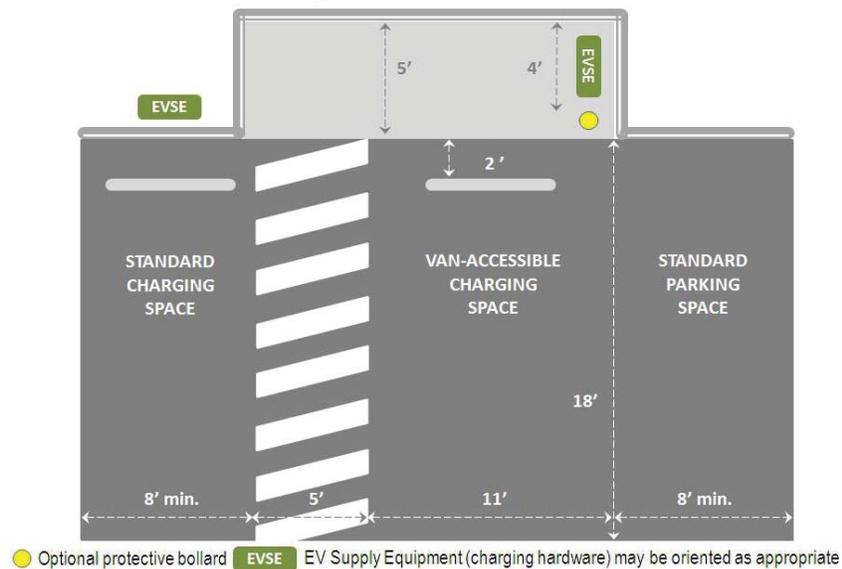


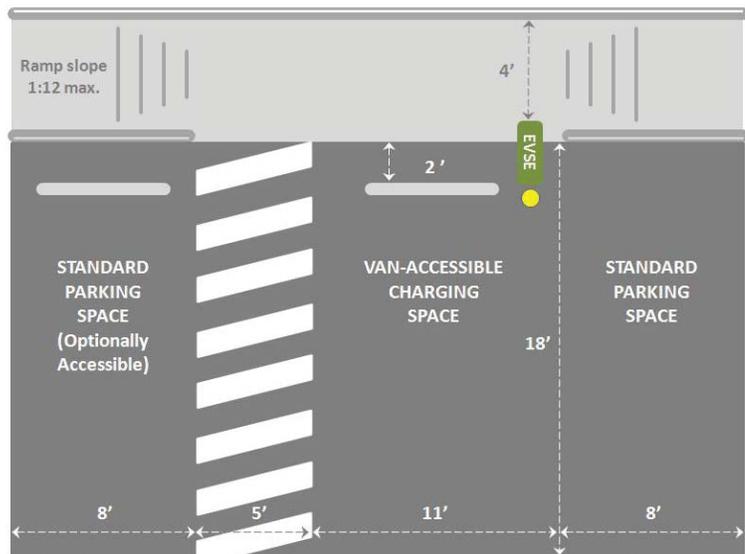
Figure 36 Installation in Parking Lots at Medians or Grade Perimeters

Local Case Studies

Both the Cities of Raleigh and Durham City/County have been leaders in the research and exploration of ADA for charging stations. The EVSE installations by Durham City/County have received state wide recognition for their attention to ADA.

Several key design features are visible in Figure 38, which is a photograph of public charging stations at a county library:

- Provision of a van-accessible charging space (eight foot wide space with adjacent access aisle greater than eight feet wide),
- Provision of an accessible route from the parking space to the charging hardware that is greater than 48" in width,
- Mounting of the charging hardware at street level and set back from the original curb line,
- Mounting of the charging hardware such that it is not in the direct line of vehicle travel to reduce the need for protection by bollards,
- Installation of bollards no closer than four feet to each other to avoid obstructing the accessible route.
- Connection to an accessible route, from the charging space to the nearest entrance of the library, which is approximately 60 feet longer than the route from the farthest existing ADA parking space at the site.



● Optional protective bollard EVSE EV Supply Equipment (charging hardware) may be oriented as appropriate

Figure 37 Installation in Parking Lots at Sidewalk Boundaries

Wheel stops were placed four feet from the curb to indicate an accessible route to the front of a parked vehicle. In retrospect these wheel stops may be unnecessary, with omission providing drivers greater flexibility for vehicle positioning.

Recommendations for ADA Compliance

Mr. Robert Shuler of the NC Department of Insurance and Office of the State Fire Marshal served as the primary contributor of recommendations for ADA compliance to the PCS workgroup. During monthly meetings, Mr. Shuler provided guidance on ADA, how it is enforced, how it relates to state and federal regulations and the process for code interpretations plus potential changes related to PEV readiness.



Figure 38 Accessible public charging station at the Durham County Main Library, Durham, NC.

Accessible Parking at a Human Services Facility

Figure 39 shows the side view across charging spaces at a county human services facility. This installation uses the same design shown in Figure 38. While wheel stops can serve to help preserve an accessible route at the front of the charging space, note that omitting them gives drivers more flexibility in the ideal positioning of their vehicle.



Figure 39 Charging stations at the Durham County Human Services Complex, Durham, NC

Over-Protection Should be Avoided

Figure 40 shows charging hardware that has been installed with a two foot curb extension, protective bollards and wheel stops. Despite the adjoining access aisle and the attached sidewalk's generous width of nearly six feet, this charging hardware may not be deemed accessible due to the protective elements creating obstruction to the space. Furthermore, the space length has been reduced to less than 13 feet from the wheel stop to the end of the stripe, which may only accommodate compact vehicles.



Figure 40 Over-protection can hinder accessibility of charging stations

On-Street Accessible Parking

Figure 41 shows an example of van-accessible on-street parking. This space does not include PEV charging at this time, and would likely require additional curb removal at the front of the space to accommodate access to the charging hardware. Figure 41 illustrates the large amount of adjacent space required for an access aisle in this configuration. Typical adjoining sidewalks on existing streets may not be wide enough to accommodate this type of installation.



Figure 41 On-street van-accessible parking requires lots of adjacent space.

Examples of ADA Codes

Accessible Route

A continuous unobstructed path that complies with this chapter. (NCBC Chapter 11). [NCBC 1102; 1104.2; ANSI 402]

Reach Ranges

The maximum obstructed or unobstructed height that can be reached from either a forward or a side wheelchair approach. [ANSI 308]

Curb Ramps or Cuts

Provides an accessible transition (maximum 1:12 slope) between changes in elevation. [ANSI 406]

Signage

Standardized PEV signage is important to raising the awareness of available charging infrastructure in North Carolina. Through the standardization of signage, wayfinding and other identification mechanisms, charging infrastructure will become more familiar to North Carolinians while increasing confidence in both the safety and reliability of this technology. The following are examples of signage recommended to be used in North Carolina based on best practices and emerging standards:

General Service Sign



Regulatory signage can be combined with general service, wayfinding and other signage



Regulatory Signage



EV Parking Only



EV Charging Only

Wayfinding Signs

Advance Turn and Directional Arrow Auxiliary Signs for use with General Service Signs



M5-1



M5-2



M6-1



M6-2



M6-3

Installation Guidelines

The following guidelines can be found within Section 2 of the Southeast Region EV Readiness Workbook [<http://www.cleancitiesatlanta.net/component/content/article/130-electric-vehicle-readiness-workbook>]. The chart below provides steps and activities that support the installation of signage for PEV parking and charging station spaces. This information is based on best practices and may not apply to certain jurisdictions in North Carolina. It is important to note that requirements may vary by jurisdiction and that compliance with federal, state and/or local regulations is the responsibility of the managing party.

Installation Examples

Figures 42-45 are examples of ideal PEV signage installations in North Carolina. While uniformity of all design aspects is not mandatory at this time, it is recommended that both public and private installations maintain a certain level of consistency in order to enhance the ease of identifying charging infrastructure. The PCS workgroup recommends that municipalities that participated in PEV readiness planning work together to begin standardizing all design elements associated with charging infrastructure.

Parking Enforcement

As seen in the previous examples, regulatory signs can be used to permit parking spaces designated for PEV charging, however, these signs are only informational and cannot regulate parking for the sole use of PEVs unless supported by local ordinance. In most case studies of PEV only parking in North Carolina, local ordinances are not in place to support regulation and instead, rely on public acceptance that the parking space(s) are reserved for a special purpose as indicated by signage that in most cases, is unique to any given municipality. The examples below show two PEV only designated parking spaces in high-traffic locations that are not regulated by local ordinance:

Placement and Clearances

(Adapted from the Southeast Region EV Readiness Workbook)

1. Signs should be no smaller than 12"W x 18"H
 - Bottom of sign shall be 7' above ground
 - Poles shall be located from 24" from the curb
 - Signs shall not be hidden by other signs or objects
 - Intersections: Signs may be no closer than:
 - 20' from the closest edge of a cross walk or
 - 30' from the corner of an intersection if no cross walk exists
 - Fire Hydrant: Signs may be placed 15' from either side of a fire hydrant
 - Driveway/Curb: Signs may be placed 10' from either side of a driveway/curb
 - ADA: signs shall not be placed within 48" of another pole
 - Right-of-way considerations
2. Sign installation
 - Where possible, signs shall be attached to City light poles or u-channel poles
 - If existing poles do not correlate with the placement of the EVSE, new u-channel poles shall be installed; other signs that are not location-sensitive will be moved to the new pole
 - Signs shall not be adhered to wooden poles, trees, or way-finding signs
 - If two or more signs exist on the same pole, then parking restriction signs (red) shall be placed above general service signs or regulatory signs (green)
 - If two or more signs exist on the same pole, then parking restriction signs (red) shall include a 6"x12" sign with a red arrow indicating where the restriction applies with respect to the sign



Figure 42 Charging Station installation at 8505 IBM Dr Charlotte, NC 28262 (Enterprise)



Figure 43 Unregulated EV only parking in high density zone (505 S Tryon St Charlotte NC 28202)



Figure 44a and 44b Unregulated PEV only parking (Durham, NC)

The City of Raleigh's City Council passed the first parking enforcement ordinance in the state of North Carolina in 2012. This was reviewed at the NC PEV Taskforce Policy, Codes and Standards working group as a local example for how to enforce EV only parking. The ordinance indicates that a vehicle must be plugged in and charging at electric vehicle parking spaces or it will be fined⁵³.



Figure 45 City of Raleigh PEV Parking Enforcement Sign (NC)

Building Codes

Updated building codes can greatly reduce the cost of installing charging infrastructure. Local building code councils typically adopt rules seen at the state, national and/or international level. The PCS workgroup approached a number of building code professionals in North Carolina in addition to presenting information to the Mecklenburg County Building-Development Commission. Interaction with code professionals allowed the PCS workgroup to best understand how building codes can support the expedited installation of charging infrastructure.

While a majority building codes already support the installation of EVSE as they currently exist, members of the PCS workgroup identified an emerging best practice seen in PEV ready communities involving EVSE conduits. Building codes that require separate conduits for EVSE improve the safety of electric circuitry in a structure while also supporting enhanced delivery of power to advanced EVSE. In addition to these benefits, dedicated conduits for EVSE will greatly reduce post-construction costs associated with additional permitting and inspection fees, and others related to the installation of new underground cable raceways when installing charging units.

The PCS workgroup recommends that the NC PEV Taskforce work with parking and property managers to familiarize them to the benefits of installing separate conduits specifically for EVSE.

The recommendation to include separate EVSE conduits in new construction projects can be implemented through adoption as a requirement by local building code councils and/or through the provision of incentives for site design that include separate EVSE conduits.

Homeowners should also be made aware of the cost benefits associated with the installation of EVSE specific conduits. Installing a cable raceway leading from the electricity circuit panel to an enclosed outlet box in the garage or carport is a recommended best practice from building code professionals.

Case Study: City of Vancouver Green Construction Standards

Adopted in 2008, the City of Vancouver, Canada, requires the installation of dedicated EVSE conduits from the building's electric panel to an enclosed outlet box in the home's garage or driveway. Dedicated EVSE conduit installation is required as follows:

1. Each dwelling unit shall have a cable raceway leading from the electricity circuit panel to an enclosed outlet box in the garage or carport.
2. A raceway not smaller than size 21 shall be provided to accommodate future conductors of a separate branch circuit intended to supply a future receptacle for use with the electric vehicle charging system.
3. An outlet box for the receptacle referred to in Sentence (2) and approved for the purpose shall be provided in a parking space or a parking stall of a storage garage or carport intended for use with the electric vehicle charging system.
4. The raceway described in Sentence (2) shall be installed between the dwelling unit panel board and the outlet box referred to in Sentence (3). <http://vancouver.ca/ctyclerk/cclerk/20080626/documents/pe5.pdf>

Permitting

A lengthy and unclear permitting process for the installation of EVSE is proven to be a key barrier to the adoption of PEVs. The PCS workgroup identified local case studies that could be replicated across North Carolina to ensure an expedited permitting with a focus on processes for private business and residential installations.

The following recommendations were developed by the PCS workgroup:

1. A standardized electrical permit template should be adopted by all permitting entities in North Carolina with support from municipalities included within the state's four region specific community readiness plans.

Examples:

PERMITTING and INSPECTIONS GUIDE
FOR
RESIDENTIAL ELECTRIC
VEHICLE SUPPLY EQUIPMENT

FREQUENTLY ASKED QUESTIONS

Why are permits required for Electric Vehicle Supply Equipment (EVSE)?
State law (NCGS 160A-417) requires the permit, and obtaining the proper permits and inspections helps ensure that the equipment is properly installed to protect the health, safety, and welfare of our citizens.

Where can I find the rules for installing Electric Vehicle Supply Equipment (EVSE)?
Rules for the installation of EVSE can be found in the latest edition of the North Carolina Electrical Code (the National Electrical Code (NEC) with North Carolina Amendments). If the installation requires work done in another trade—such as mechanical for ventilation—that work must be done in accordance with the applicable NC Code.

HOW TO APPLY FOR A PERMIT

Apply for a permit in just two simple steps:

- Have Your Equipment Plan**
 - Equipment layout
 - Electrical requirements for equipment
 - Size of electrical service (proposed or existing)
 - Ventilation requirements
 - Provide all equipment and plan documents on-site at the time of inspection
- Complete Permit Application Online**
 - Enter all pertinent plan and equipment details in the Notes section of the online application
 - Payment is required at the time of application for online permit applications

PROCESSING TIME
Processing time for EVSE online permit applications is approximately two business days from the submittal date of a complete and accurate application. Upon approval, your permit will be emailed to you.

FEES
The minimum permit fee (\$60) is applied per trade.
The example below shows the permit fees for a typical residential EVSE installation:
Electrical Permit (\$60) + Mechanical Permit* (\$60) = \$120 Total Permit Fees
*if ventilation is required
Actual fees may vary, depending upon the specific installation. For a complete listing of current fees and rates per the Town of Cary's approved budget, please visit the Inspections & Permits Web page at www.townofcary.org.

Figure 46 Town of Cary, NC, Permitting Inspections Guide Example

Mecklenburg County
Land Use and Environmental Services
P.O. Box 31697
700 N. Tryon St.
Charlotte, NC 28231-1097
(704) 336-3530

Master Permit:
Permit: E2363620
Issue Date: August 09, 2012

Electrical Permit

Property
Address: 1715 BAY ST Unit 4
Subdivision: Parcel: 12701102 Lot: Block: Tax Jurisdiction: CHARLOTTE

Project
Project Number: NR0194449
Project Name: Electric Vehicle outlet upgrade
Property Use: Residential - One/Two Family
USDC: 434 - Housekeeping Buildings (additions, chimneys, conv.)
Building Type: Existing Bldg
Equipment Type: New
Contract Cost: \$200

Contact Details
Owner: Contractor: JOHN DOE
Phone: Contractor ID: Home Owner: Yes
Address: Phone: (704) 333-3623
License #: Address: 3607 N. SHARON AMITY CHARLOTTE, North Carolina 28205

Fees
Permit Fee: \$62.85 Fax Fee: \$0.00 Fire Damage Fee: \$0.00
Triple Fee: \$0.00 Fee Adjustment: \$0.00 Commercial Surcharge Fee: \$0.00
Charge To Account: N Paper Application Fee: \$0.00 Plans Conversion Fee: \$0.00
Other Agency Coll Fee: \$0.00 Total Fee: \$62.85

Miscellaneous
Entry Date: 08/09/2012 10:41 am Entered By: Drennan, Rob
Issue Date: 8/9/2012 Issued By:
Utility Company: DUKE ENERGY Equipment Changeout: N
Ready for Inspection: N

Items Installed

Description	Quantity	Description	Quantity	Description	Quantity
Electric Vehicle 120 Volt Circuit	Yes	Electric Vehicle 240 Volt Circuit	Yes		

Remarks
Your project has been assigned to the following inspection team for project assistance: South Team @ 704-336-3534.
This permit will expire if work either has not started within 6 months or is discontinued for a period of 12 months. No credit or refund will be given unless applied for within 120 days after a permit has expired.

Page 1 of 2

Figure 47 Mecklenburg County, NC, Permitting Inspections Guide Example

2. Permitting entities in North Carolina should consider waiving inspection fees associated with EVSEs. The NC PEV Taskforce should work with PEV readiness communities to develop this structure. Example: First 100 EVSE permit fees within a county waived and/or workplace charging EVSE permit fees waived/discounted.

3. Same-day permitting for residential installations of electric vehicle charging stations should be offered. This would allow an EVSE installer to apply for and receive an electrical permit within a 24-hour period.

4. Next-day inspections for residential installations of electric vehicle charging stations should be offered. This recommendation would require the State Electrical Inspector to prioritize EVSE installation inspections and target an inspection in a 24-48 period following the initial notification.

Local Case Study: Online Permits for Trades (Mechanical, Electrical and Plumbing)

Mecklenburg County requires contractors to have a permit for certain projects and now it is an easy online process. The contractor Trades Internet Permits (TIP) online process allows you to enter details of the work being performed for projects that do not require a Building permit, pay the permit fee and print the permits.

The benefits of obtaining a permit from this website are:

- The primary contractor may submit, pay for, and print a permit for projects such as change-outs, without staff intervention, 24 hours a day, seven days a week.
- Primary contractor should apply and pay for all sub-trades. Mechanical contractor is considered to be the primary contractor when the project requires Mechanical, Electrical & Plumbing work. Plumbing contractor is the primary contractor for electric water heater change-outs. Electrical may be the primary only on projects not requiring mechanical or plumbing work, such as a service upgrade.
- Upon completing the on-line process, a contractor can immediately request inspections as soon as the work is performed. The county will send certified inspector(s) to verify code compliance.
- Because of an increase in permit fees taking effect July 1, 2009, individual permits will now start at \$60. For projects that require both an electrical and mechanical permit, for example, the cost would be at least \$120. Contractors who use TIP will be charged \$90 - a savings of \$30. A larger project would incur higher permit fees.
- The "Submit Permit Application" is available if your project is outside of the scope of the TIP process.

Zoning Ordinances

Zoning ordinance and unified development ordinance updates were discussed at the NC PEV Taskforce Policy, Codes and Standards Working Group. Research for the zoning ordinance section was pulled from a variety of locations including:

- Ready Set Charge California: A Guide to EV-Ready Communities- www.ReadySetCharge.org
- A Toolkit for Community Plug-In Electric Vehicle Readiness- California Plug-In Electric Vehicle Collaborative- www.pevcollaborative.org
- Zoning Amendment for Electric Vehicle Charging Stations- Methuen Massachusetts
- APA Zoning Practice for EV Infrastructure
- Electric Vehicle Infrastructure: A guide for Local Governments in Washington State
 - Plug conducted a phone interview with Planner in Washington State who was lead in developing the model guidelines.

Zoning and unified development ordinances are written to serve as the implementation for a community's future land development vision established in planning policies. Applicable policy documents that work in conjunction with a zoning ordinance include General Statutes and Comprehensive Land Use Plans. Within a zoning ordinance or unified development ordinance, there are certain standard sections that may apply to PEV infrastructure installations. The following may require review and possible amending to adequately prepare an ordinance for PEV adoption.

Trade Internet Permitting (TIP) System as expedited permitting option for EVSE

Mr. Joseph Weathers serves as the Electrical Code Administrator for Mecklenburg County and was an active participant in both the statewide PCS workgroup and local community PEV readiness planning effort specific to the greater Charlotte region. During the March 2012 PCS workgroup meeting, Mr. Weathers gave a general overview of the permitting process from the perspective of a local code enforcement agency followed by an example of Mecklenburg County's 'Trades Internet Permits' (TIP) online process which allows contractors to enter details of the work being performed for projects that do not require a building permit, pay the permit fee and print the permits.

Definitions

Clearly defining PEVs and the various types of PEV charging stations is highly recommended to reduce inconsistencies in interpretations by both code officials and users. The same definitions should be used throughout the document and in the Table of Permitted Uses.

Table of Permitted Uses

In many zoning ordinances, if a use is not included in the Table of Permitted Uses then it is “not permitted.” This opens up the possibility of inconsistent or incorrect interpretations. Therefore, charging stations should be included. It is recommended that level one and level two charging stations to be permitted as accessory uses to the primary use of a site.

Streets, Sidewalks and Public Places

The streets, sidewalk and public places section of an ordinance will apply to on-street parking and PEV charging. The following should be considered for this application:

- Encroachment agreements
- Utility easements
- Signage requirements
- Cord management
- Streetscape and overlay requirements

Off Street Parking

Charging Stations located within parking lots will be regulated in the location and design criteria section of the Off-Street Parking section of an ordinance. The following items should be considered:

- Minimum parking requirements
- Parking stall size requirements
- Requirement for pre-wiring or a minimum number of charging stations
- Charging station placement (including placement on a sidewalk)
- Charging station protection (requirement for curbs, bollards, and wheel stops)
- Lighting

Architectural Requirements

Many ordinances contain design standards to promote quality and aesthetically pleasing developments within the community. PEV charging stations may be subject to these regulations which could include regulations on colors and screening. Charging stations need to be highly visible and an unintended consequence of a screening ordinance may result in the charging station being difficult to find by users.

In early 2013, Advanced Energy will release more information on zoning, based on the work started in the Policies, Codes and Standards Working Group. This information will be included in the Plug-in Electric Vehicle Planning Toolbox, which will be an addition to the Community Planning Guide for Plug-in Electric Vehicles, <http://www.advancedenergy.org/transportation/resources/>



Figure 48 Screening of Charging Station example.
Source:
http://www.transformbaltimore.net/portal/transv2/landscape/landscape_ordinance?pointId=d153150e4639

Historic Districts

Representatives from the North Carolina Historic Preservation Office and City of Raleigh Planning Department presented information regarding historic preservation and PEV charging infrastructure to members of the NC PEV Taskforce focusing on ways to incorporate electric vehicles into local historic districts.

Some of the considerations included the following:

- Permitting charging stations (certificate of appropriateness) – the PCS working group recommends that permitting for charging stations be similar to permitting a use such as a satellite dish, which requires a certificate of appropriateness.
- Education of Local Historic District Officials- One of the biggest barriers to electric vehicle adoption, within a local historic district, may be the local commissions who may not be familiar with charging stations and in turn disapprove the request. The PCS working group recommended that educational materials are produced to inform local historic commissions on charging stations as well as best practices for installations.

A representative from the North Carolina Historic Preservation Office indicated that their department could work with the NC PEV Taskforce Policy Codes and Standards Working Group to developed guidelines for local historic commissions.

Encroachment Agreements

Charging stations for plug-in electric vehicles (PEVs) are being placed in a variety of locations to serve plug-in electric vehicle drivers. These locations include not only off-street parking lots, but on-street parking as well. For charging stations installed to serve on-street parking facilities, the installer generally must obtain an right-of-way (RoW) encroachment agreement from the proper entity.

The Policy, Codes and Standards Working Group met with local officials and NC Department of Transportation (NCDOT) who provided guidance on the process for obtaining an encroachment agreement for electric vehicle charging stations. From this discussion, it was discovered that there are certain sections in the regulations which may need clarification. Additionally, officials indicated an opportunity to address this challenge in conjunction with an upcoming rewrite of the current codes.

The following considerations are recommended to be explored when obtaining an encroachment agreement:

- Determine who maintains the road: state (NCDOT), local municipality, or privately-owned
- Processing time: Encroachment agreements can take four-to-six weeks
- Ownership and Maintenance of the Charging Station: There may be restrictions on the type of entity that may be able to install a station within the RoW.
- Consider underground Utilities in the RoW
- Performance Bond: Bonds may be required for some installations

In early 2013, Advanced Energy will release more information on encroachment agreements, based on the work started in the Policies, Codes and Standards Working Group. This information will be included in the Plug-in Electric Vehicle Toolbox, which will be an addition to the Community Planning Guide for Plug-in Electric Vehicles, <http://www.advancedenergy.org/transportation/resources/>

The example below is a hypothetical case study explored by the PCS working group. Representatives from NCDOT indicated that it is always recommended to contact your local NCDOT office first because each site will be evaluated depending on unique site circumstances. The discussion revealed the considerations for encroachment agreements which are listed above.

Encroachment Agreement Case Study

The proposed charging station will be located on the main street of a downtown. The charging station is being installed by the town. The town will also maintain the charging station. The charging stations will be placed on the sidewalk adjacent the on-street parallel parking. The NCDOT right-of-way extends 35' from the center line of the road (to the back of the sidewalk).



Figure 49 Example of proposed charging station installation site

Planning Documents

Research revealed there are a number of benefits to including electric vehicle readiness planning at several levels of planning documents including comprehensive plans, and strategic plans. In certain cases, such as zoning, state law requires that zoning amendments include a consistency statement with the adopted comprehensive land use plans⁵⁴. Examples of local plans discussed within the PCS workgroup included:

Comprehensive Land Use Plans

It is recommended to include language in the Comprehensive Land Use Plan to encourage PEVs and associated infrastructure such as charging stations. Encouraging these technologies can help to achieve many goals that a comprehensive plan may already have such as greenhouse gas reduction strategies and air quality goals. Additionally, this will provide the justification needed for local ordinance modifications.

Local Example: The City of Raleigh, in Chapter Three of their Comprehensive Plan, has included policy language in its comprehensive plan to encourage the adoption of electric vehicles and electric vehicle infrastructure⁵⁵.

Strategic Plans

Strategic Plans are local government plans that provide specific goals and details on how to provide implementation.

Local Example: Durham City/County Electric Vehicle and Electric Vehicle Charging Station Plan- The joint Sustainability office for the City and County worked with department heads and local leaders to develop a strategic plan which provided specific guidance for the installation and maintenance of the city/county owned fleet vehicles and charging station installation⁵⁶.

<http://durhamnc.gov/ich/cmo/sustainability/Documents/Durham%20EV%20and%20EVCS%20%20Plan.pdf>

Small Area Plans, Streetscape Plans

A small area plan will provide greater details on the character of a certain area within the city or county limits. It is recommended that PEV considerations are worked into these plans.

Communication Strategies

The NC PEV Taskforce surveyed a number of community stakeholders to determine the best strategies for assisting new PEV owners navigate local policies, codes and standards. The following is a list of recommendations for local municipalities to include within educational materials for PEVs and charging infrastructure:

Strategy Identified

- Website/online resources (one central location)
- Create a brochure/flowchart
- Produce a guide, similar to Town of Cary's and City of Raleigh's – make available online
- Include residential permit as part of electrical permit
- Commercial permits processed through standard site plan review process
- Cost could be a stumbling block
- Local Governments
- Have historic district commissions create ordinances/rules
- Have one person/entity that PEV owners work with for residential installations
- Email/list serves
- Social media- twitter, blogs
- Events
- Partnerships with Car Dealerships



Recommendations for City/County PEV Plans

Ms. Tobin Freid supported the PCS workgroup by presenting information about the creation of Durham City/County Electric Vehicle and Electric Vehicle Charging Station Plan. This plan has been cited as a model for PEV readiness by a number of communities outside North Carolina and provides a local resource for municipalities in the state to address the number of policies, codes and standards necessary to prepare for PEVs and charging infrastructure.

Legislative Considerations

Today, about half of the oil we use is imported, and our dependence will increase as we use up domestic resources. Most of the world's oil reserves are concentrated in the Middle East, and about two-thirds are controlled by Organization of the Petroleum Exporting Countries (OPEC) members. Oil price shocks and price manipulation by OPEC have cost our economy dearly—about \$1.9 trillion from 2004 to 2008—and each major shock was followed by a recession.

PEVs offer a solution to U.S. oil consumption while offering environmental benefits associated with air quality and the reduction of greenhouse gas emissions. Though a seemingly obvious solution to an urgent problem, the successful deployment of PEVs and charging infrastructure will require legislative policies that support the advancement of a new technology where a market gap is present. While battery costs are dropping at a steady rate of about eight percent per year along with advancements in charging technology and range, North Carolina's PEV Roadmap is an essential tool that will support the state's navigation through the transformation of the vehicle market.

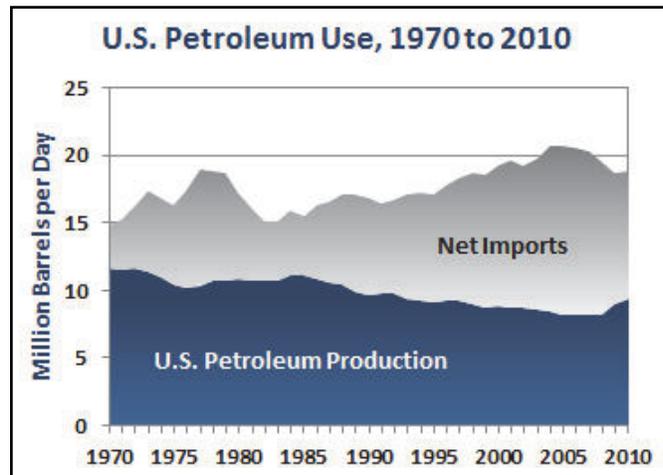


Figure 50 U.S. Petroleum Usage

PEVs challenge old habits and vested interests, so a concerted effort is needed to move them from emerging status to self-sustaining major market. Federal policies will be necessary, but they will not be sufficient. State and local policies are already more advanced and are likely to be more durable, as they engage motorists, local decision makers, and auto dealers. – Carnegie Endowment for International Peace

North Carolina can support the adoption of PEVs through legislative policies that cultivate local PEV clusters within the state's PEV readiness regions – greater Asheville, Charlotte, Piedmont Triad and Triangle areas. These communities are the leaders behind the state's PEV Roadmap and are now working to implement recommendations seen throughout this document as developed by stakeholders at the local level. These four regions will serve as leaders to municipalities across the state as North Carolina becomes PEV ready. In order to support the implementation of these recommendations, legislation must be flexible, support demonstrations, support experimental rate and incorporate best practices as we go.

Legislative Policies and Economic Development

NCSEA helps develop and maintain a legislative and regulatory environment that supports the North Carolina Renewable Energy and Energy Efficiency Portfolio Standard, information transparency, clean energy financing options, and fair transmission and distribution access. The association engages the state's clean energy business community that advocates for a supportive legislative and regulatory environment.

The following are examples of legislative policies in North Carolina to note when considering PEV readiness:

Third-party public infrastructure (EVSE) providers

Some states are beginning to enact legislation allowing the sale of electricity for PEVs. In May 2012, the State of Colorado passed legislation allowing for entities to obtain a license to install and sell alternative fuels for electric and natural gas vehicles (HB 1258, 2012). This new law was intended to foster the markets and business models for alternative fuel vehicles, by allowing for venues such as shopping centers, entertainment districts, downtown areas, and workplaces to sell alternative fuels.

Road Taxes (gas tax) for PEVs

National consensus agrees that for many reasons, any policy that addresses road tax revenue should not single out PEVs or any alternative fueled vehicle for several reasons. Specific to PEVs, the adoption of the transportation technology will take time, meaning it would be several years before revenues from the taxing of fuels other than gasoline are noticeable. Additionally, as manufacturers continue to offer an increasing number of fuel efficient vehicles, PEVs are but one small factor within the entire scope of this policy issue.

Examples of Specific 2011-2012 Bills in North Carolina Relating to PEV Readiness:

- *H1139, Promote Renewable Jobs (proposed Session 2011-12):*
www.ncleg.net/gascritps/BillLookup/BillLookup.pl?Session=2011&BillID=H1139
- *H177, Clean Energy Transportation Act (ratified Session 2011-12):*
www.ncleg.net/gascritps/BillLookup/BillLookup.pl?Session=2011&BillID=H177
- *H1054/S820, Clean Energy & Economic Security Act (proposed Session 2011-12):*
www.ncleg.net/gascritps/BillLookup/BillLookup.pl?Session=2011&BillID=H1054

North Carolina stands to benefit from the adoption of PEVs and charging infrastructure and can do so through the support of legislation that avoids state tax revenue loss. Economic development opportunities including the creation of jobs in the state's emerging PEV industry, along with research opportunities related to development and component manufacturing opportunities are two examples of areas in which North Carolina is well positioned to achieve.

Conclusions & Recommendations

North Carolina's communities have been cited in multiple PEV research documents both on the national and international level because of their leadership role in developing, implementing and improving policies, codes and standards that support the adoption of PEVs and charging infrastructure. The state's community colleges, business community and research universities afford a positive climate for the continued improvement of these issues that are crucial to the development of the state's PEV industry and associated infrastructure.

The NC PEV Taskforce Policy, Codes and Standards Working Group focused on items included within the US Department of Energy Sample Plan Outline for PEV Readiness and worked with local stakeholders to study what recommendations should be considered that would streamline the rollout of PEVs and charging infrastructure. The recommendations included within are designed to be easily replicated by those entities within the state that continue to pursue the adoption of PEVs in North Carolina and are intended to guide the creation of advanced resources specific to both the creation and understanding of policies, codes and standards that support the expected increase in PEV penetration within the state's 100 counties.

Table 9. Policy, Codes and Standards Working Group Recommendations

	Recommendation	Examples	Time Frame*	Priority Level**
R.1	Develop State Guidelines for ADA Accessibility	“EV Charging Stations for Persons with Disabilities” – Clean Fuels Ohio and Virginia Clean Cities PEV Toolkit- Advanced Energy	Short-Term	High
R.2	Provide identification signs and wayfinding signage to help locate charging stations.	PEV Toolkit- Advanced Energy	Short-Term	Medium
R.3	Actively monitor National Electrical Code revisions	Revisions will likely include a recommendation that Building Code Councils require separate electrical conduits for EVSE	Mid-Term	Medium
R.4	Permitting: <ul style="list-style-type: none"> • Incorporate EVSE process into permitting processes (24-48 hr process) • Encourage local governments to develop hand-out or guidelines to define permitting process • Train Local Permitting Officials 	Mecklenburg County Code Enforcement’s e-Permitting and e-Plan Review through the Trades Internet Permits (TIP) online process	On-going	High
R.5	Update Local Zoning Ordinances to provide guidance for infrastructure placement Encroachment Agreements Update right of way permitting to allow for EV infrastructure to be placed in state and local right of ways		Mid-Term	Medium
R.6	Technical Training: Encourage Local Governments to train their Permitting Offices and Inspectors		Mid-Term	Medium
R.7	Legislative Considerations: Work with organizations such as NCSEA to monitor and encourage PEV related legislation		Mid-Term	Medium
R.8	Model Plans: Encourage local governments to adopt electric vehicle policies into their governing plans such as comprehensive plans, sustainability plans, strategic plans and small area plans.		Mid-Term	Medium
*Term Lengths for Recommendations				
	Term	Description		
	Short-Term	1 to 2 years		
	Mid-Term	3 to 5 years		
	Long-Term	6 to 10 years		
	On-going	No set start or end time		

EDUCATION AND OUTREACH



6

Authored by:

NC PEV Taskforce Education and Outreach Working Group

Led by:

Advanced Energy

EDUCATION AND OUTREACH

Introduction to Education and Outreach

With the emergence of PEVs in the marketplace and the rapid evolution in PEV technology, Education and Outreach is recognized as both an opportunity and a barrier to widespread PEV adoption and readiness. The Education and Outreach Working Group committed to building relationships with key stakeholder groups to inform stakeholders of developments in the PEV industry and to engage stakeholders in planning for the electric drive revolution in North Carolina. This working group formulated strategies to increase general PEV awareness among stakeholders such as the green workforce, the public, state and local government and key organizations. The initiatives that came out of the Education and Outreach working group are vital to the understanding, planning and successful implementation of PEVs throughout North Carolina.

Existing Initiatives in Education and Outreach

National Examples of Education and Outreach Initiatives

The Education and Outreach Working Group reviewed national examples of education and outreach initiatives for plug-in electric vehicles. Some key examples are listed below.

Oregon

- Partner with the Oregon Automotive Dealers Association, IBEW, NECA, OBCD and Portland Community college to provide training to key audiences:
 - Personnel at auto dealerships – provide training on customer needs, benefits, sales and key facts related to PEVs
 - College Students – Integrate PEV Information into the existing hybrid program for automotive students and provide a first responder training course
 - Electricians – Provide installation and inspector training
- Partner with the Oregon Automobile Dealers Association, Columbia Willamette Clean Cities Coalition and Rogue Valley Clean Cities Coalition to develop geographically dispersed outreach and communication strategies and plan

Washington State

- Create a website for public information related to PEVs and EVSE in Oregon
<http://www.electricdrive.wa.gov>
- Public Information and Education Needs
 - Provide education and outreach to the general public about long range planning for infrastructure for the state
 - Work with car dealers, electricians, EVSE distributors and utilities to provide consistent and accurate information to consumers about charging infrastructure access and availability
 - Provide education to fleet operations with a greater emphasis on financial benefits of adding PEVs to fleets
 - Outreach to the general public about Personal and Public Safety of PEVs
 - Permitting, Construction, Electricians as a target audience for training opportunities

Electric Ride Colorado

- The public outreach and marketing campaign for Colorado is called “The Electric Ride.” The Electric Ride website will engage the public in the EV movement through a fun and educational website, viral marketing, and social media.

California: PEV Collaborative

- Increase Consumer Awareness and Demand for PEVs through Public Outreach
 - Institute a Broad-based communications campaign
 - Private and public stakeholders should cooperate to develop a broad campaign that delivers consistent messaging
 - Provide Opportunities for all Californians to experience PEVs
 - Automakers, government, utilities, and other stakeholders can collaborate to provide a wide range of opportunities for Californians to use PEVs in real-life settings and understand how they drive, charge, and generally feel. Beyond “ride ‘n drive” events, creative promotions could incorporate PEVs into business, carsharing, rental, taxi, and driver education fleets.
 - Create a trusted information Clearinghouse
 - Stakeholders should collaborate to develop a website with comprehensive and impartial PEV information for California consumers and other stakeholder audiences.
 - Lead by Example
 - If government, business, and cultural leaders drive PEVs, interest and confidence in the technology will develop. A “lead by example” philosophy could permeate throughout the state to make PEVs more visible every day.

Local Examples of Existing Education and Outreach Initiatives

Examples of some local education and outreach initiatives are listed below:

- NC PEV Taskforce website
 - The NC PEV Taskforce website serves as the connecting communications piece between North Carolina’s regions for providing updates on community readiness initiatives across the State.
- Go4PEV.org
 - Local municipalities in the Mecklenburg County region partnered with Centralina Clean Fuels Coalition (CCFC) to communicate with their communities, consumers and stakeholders about the progress of PEVs in the greater Charlotte area. GO4PEV is an umbrella outreach effort to be used for up-to-date information about what is happening locally and regionally with electric drive transportation
- The City of Charlotte
 - The City of Charlotte has developed training on how to drive PEVs for their internal staff
- The City of Raleigh developed the following education materials for PEVs in their community:
 - YouTube videos on charging station installations
 - An online charging station location map that includes public charging station locations throughout the greater Triangle region
- The City of Durham and the Durham County government created the following resources to provide education about PEVs in their respective communities:
 - Employee training for driving a Nissan LEAF
 - Employee training for engaging with the members of the general public to provide education and outreach about publicly funded EVSE
 - A charging station location map
 - A FAQ document about PEVs in the city of Durham and throughout Durham County
 - A fact sheet about the City and County’s charging station plan
 - A politically adopted plan for PEVs that is publicly available
- North Carolina State University
 - NC Solar Center created a fact sheet about PEVs that is available online
 - Sustainable Transportation Education Program (STEP)
 - A collaborative effort with North Carolina State University’s NC Solar Center in the College of Engineering and the College of Education. STEP is a program educating middle and high school students on sustainable transportation and the current shift towards the electrification of transportation.

- EV Challenge
The Electric Vehicle (EV) Challenge is an education program that engages high school students in advanced electric drive technology through real-world, hands-on experience. The program features students who participate in a yearlong educational program and learn about engineering, environmental science and electronics. Through the curriculum students gain critical thinking, problem-solving and public speaking skills. Students then work as a team and use their skills to design, construct and operate a street-legal, full-size PEV. These vehicles are competed in a series of events where students determine the range and performance of their vehicle while educating the public about PEVs and electric drive technology. In addition to running an educational program, the EV Challenge provides teachers with a comprehensive electric vehicle curriculum, seminars, and fund-raising support.

Advanced Energy

- Technical Trainings
 - Advanced Energy offers technical trainings for permitting, inspections and code officials and electricians for EVSE installations.
- Community Planning Workshops
 - Advanced Energy offers community planning workshops that provide guidance on how to begin planning for PEVs, case studies of planning efforts in select cities and regions, and general information about PEVs and the PEV industry.
- PEV 101 Education Forums
 - Advanced Energy provides general information through a PEV 101 presentation that highlights PEV technology and infrastructure
- First Responder Training
 - Advanced Energy works with Duke Energy to connect the first responder community to the NC Community College system for First Responder trainings. The trainings consist of a day-long course which includes a general overview of first responder training and hands-on training with PEVs. This course is taught by an automotive instructor and a first responder trainer.
- LEAFing the Pump Behind Blog
 - Advanced Energy hosts a blog that features driver experiences with the Nissan LEAF.
- Twitter Account
 - Advanced Energy hosts a twitter account that is used to dispel myths related to PEVs, provide information on upcoming events and to communicate with local PEV owners.
- Guides and Resources
 - *Community Planning Guide for Plug-in Electric Vehicles*
 - *Charging Installation Handbook for Electrical Contractors and Inspectors*
 - *Residential Charging Station Installation Handbook for Single- and Multi-Family Homeowners and Renters*
 - E-Learning Course on Electric Vehicle Supply Equipment Installations (partner with JADE Learning)
- FAQs
- EVSE online tool
 - Advanced Energy's website hosts an EVSE tool that provides general and technical information on a variety of charging options.

Goals and Objectives

- Identify barriers and perceptions related to PEVs
- Identify target audiences for education and outreach
- Develop key messages to disseminated to each target audience
- Develop resources to aid in providing education and outreach
- Identify opportunities to create or support training related to PEVs
- Develop a plan for marketing PEVs in North Carolina

Working Group Members

Seventeen organizations ranging from non-profit organizations to utility companies participated in the Education and Outreach Working Group. The list of participating organizations can be found at the beginning of this plan.

Focus Areas

1. Education, in general as established by DOE guidance.
2. Outreach, in general as established by DOE guidance.
3. Training opportunities related to PEVs as established by DOE guidance.
4. Marketing, as established by DOE guidance

Education and Outreach as Part of Plan

Overview of Types of Education and Outreach Events

Technical Trainings

Advanced Energy in coordination with its regional partners provided technical trainings for electric inspectors, electrical designers, general contractors, facility engineers and project managers. The trainings included information on code requirements, design recommendations and best practices offered through case studies.

Community Planning Workshops

Advanced Energy in coordination with its regional partners provided community planning workshops for community stakeholders interested in understanding, planning for and implementing electric transportation in their respective communities. These workshops included a general overview on PEVs and charging infrastructure, and key considerations for municipal preparedness.

First Responder Trainings

Advanced Energy in partnership with Duke Energy coordinated and sponsored hands-on PEV First Responder Training for North Carolina first responders through the North Carolina Community College system. This training offered in partnership by Wilson Community College and the North Carolina Department of Insurance provided first responders with an opportunity to work with the all-electric vehicles, as well as electric-gas hybrid vehicles. Through this training, first responders learn about electric drive technology and gained a better understanding of how electric drive vehicles differ from conventional vehicles in relation to fire control and extrication strategies.

PEV 101 Forums

Advanced Energy provided PEV presentations that focus solely on this history of PEVs, PEVs today, high level presentation of charging infrastructure and expected trends, and benefits electric drive technology. These presentations sometimes featured information on opportunities for economic development and owner panel discussions. Advanced Energy often coordinated a vehicle display and/or a ride and drive opportunity for PEV 101 forums.

General Education and Outreach Activities

North Carolina organizations and stakeholders who support PEVs promote electric drive transportation at public events and corporate events across the state of North Carolina.

Table 10. Education and Outreach Efforts by Type/Number of Attendees	
Total Number of Events by Type	Number of Attendees
Triad First Responder Training	8 – size of class restricted due to hands-on training
Western Wake County First Responder Training	8– size of class restricted due to hands-on training
Conover First Responder Training	35– size of class restricted due to hands-on training
Triad PEV Lunch and Learns	30
Triad Community Planning Workshop	7
Coastal Region PEV 101 and Community Planning Workshop	Approx. 18
Triad Technical Training	14
Asheville Technical Training	15
Charlotte Region Technical Training	23
Charlotte Region Community Planning Forum	30
Greater Wake County Technical Training	15
Charlotte Region PEV Awareness Week	Approx. 200
Triangle Region PEV Awareness Week	Approx. 500
Triangle National Plug in Day	Approx. 50
Raleigh Earth Day Event	Approx. 200
IBM Earth Day Event	Approx. 100
Marbles Museum Outreach	Approx. 30
Journey of the Electric Car Event	Approx. 60
Centennial Campus PEV 101	Approx. 25
Centennial Campus Sustainability Day Ride and Drive	Approx. 100
NCSU Football Fan Zone	
NC Energy Office State Conference	Approx. 100
Biogen Idec PEV 101	Approx. 30
RTI PEV Education Forum	Approx. 75
GlaxoSmithKline Sustainability Day Events	Approx. 50
Pentair PEV 101	Approx. 30
City of Raleigh Lunch and Learn and Ride and Drive	Approx. 20
Urban Design Center Lunch and Learn	Approx. 20
Triangle Air Awareness Ozone Awareness Kickoff Event	Approx. 60
Durham Farmers' Market	Approx. 25
North Hills Farmers' Market	Approx. 50
EV Challenge at the Democratic National Convention	
National Alternative Fuels Day – Odyssey Event	Approx. 40

Asheville

Technical Trainings

Please visit the Greater Asheville PEV Readiness Plan for a full summary of education and outreach events.

Greater Charlotte Area

The Greater Charlotte Region hosted a technical training, a community planning forum and a PEV Awareness Week between 2011 and 2012. Charlotte's Technical Training provided information on code requirements, best practices for EVSE installation and features a case study of the City of Charlotte's EVSE installations. This workshop featured presentations by Gerald Harvell, President of Keeping Current, LLC and retired chief electric inspector of the Charlotte/Mecklenburg Inspections Department; Kristy Crisp, Business Services Manager for the City of Gastonia, David Smith, Project Leader for charging station installations for the City of Charlotte and Cyrus Dastur, Technical consultant for Advanced Energy.

Charlotte's Community Planning forum included a general overview of PEVs and Community Planning. This meeting also served as a kickoff community planning forum for the M2S grant. The forum featured presentations by Lisa Poger, Project Manager for Advanced Energy, Katie Drye, AICP, Project Manager at Advanced Energy, Jason Wager, Sustainability Program Manager at Centralina COG and Jessica Bishop, Director of the PEV Program Development at Duke Energy.

Charlotte's PEV Awareness Week featured a movie showing of "Revenge of the Electric Car" followed by a panel discussion on the PEV industry, an NC PEV Taskforce Quarterly meeting, a Ride and Drive event at the Charlotte Motor Speedway and an industry roundtable discussion. All events took place in coordination with the Hybrid, Electric, and Advanced Truck Users Forum (HTUF) Conference.

Piedmont Triad

The Piedmont Triad region hosted Advanced Energy and Duke Energy for two PEV 101 roundtable discussions in late 2011. These discussions featured an overview of PEVs by Advanced Energy, the utility perspective on PEVs by Duke Energy and a local example of charging station installations in the region. In 2012, Advanced Energy presented a community planning workshop that featured a presentation by the City of Durham about Durham's PEV adoption plan, and a technical training workshop that covered best practices for charging stations installations and code requirements.

Greater Triangle Area

The Triangle region hosted several PEV 101 Lunch and Learn events on corporate campuses and through ride and drive events throughout the region. The Triangle region also participated in several community events with PEVs on display for education to the general public. In October, the Triangle region hosted a PEV Awareness Week that featured a lunch and learn on PEVs and a number of public events. Also in October, the Triangle region hosted a technical training featuring presentations and a case study by the City of Raleigh and a presentation of best practices by Advanced Energy.

Education and Outreach as Part of Plan

Michael Thornton, Program Coordinator for The Sustainable Transportation Education Program, (STEP) and Dr. Pam Carpenter, Education Program Manager for STEP

Michael Thornton provided an overview of the STEP program which included the program's goals, initiatives and outreach. Dr. Carpenter discussed the importance of the STEP program in encouraging young women and minorities to be engaged with science and math at an early age to become future leaders in science, math and technology. The STEP program provided great information on how to get young children and schools involved in PEV education.

Cecilia Bush, EV Operations Manager, Nissan Southeast Region

Cecilia provided an overview of the dealership training program provided by Nissan for LEAF salespersons. Cecilia also discussed ways the NC PEV Taskforce can support dealers throughout North Carolina in providing information to early adopters about local incentives, community planning efforts and infrastructure to support PEV adoption. Cecilia provided great information on Nissan's perspective of target audience for early adoption and how to support early adoption. Cecilia also explained Nissan's process for educating its dealers on PEVs.

Ryan Turner, Local Volt Owner

Ryan spoke to the Education and Outreach working group about his advocacy initiatives in the Triangle region for PEVs. Ryan was featured in several local newspapers about his perspective on PEVs and was also featured on a radio talk show about the benefits of driving a PEV. Ryan also discussed how to pitch stories to the local media and best practices for answering critical questions from the media. Ryan is a PEV owner goes above and beyond to promote PEVs in the Triangle area. Ryan provided great information on how to capture the attention of a key audience, the media, and provide positive and accurate information about PEVs.

Chris Best – NC Department of Insurance, First Responder Training Manager

Chris Best discussed the need for PEV First Responder training in North Carolina. Chris discussed how first responder training can be implemented throughout the state with the support of NCDOL and also discussed some of the barriers in training first responders about electric drive technology and emergency preparedness. Chris discussed NCDOL's current partnership with Advanced Energy, Duke Energy and Wilson Community College to pilot hands on first responder training throughout the state. Chris provided great information on how the NC PEV Taskforce can support PEV First Responder training. Chris also provided insight on first responder training in North Carolina.

Rich Cregar – Instructor and Head of the Advanced Transportation Technologies Department at Wilson Community College

Rich Cregar provided the Education and Outreach Working Group with an overview of Wilson Community College's PEV First Responder Training and Wilson Community College's PEV training courses. Rich provided the group in depth information on the type of curriculum needed for first responder training. He also discussed barriers and opportunities for delivering PEV first responder training throughout the community college system in North Carolina. Rich also informed the group of funding opportunities for additional PEV training through the community college system in North Carolina. Rich discussed Wilson Community College's current partnership with Advanced Energy, Duke Energy and NCDOL to pilot hands on first

responder training throughout the state. Rich has an excellent background in curriculum development and delivery in the North Carolina Community College system. Rich provided insight to the group on how the community college system works and how the NC PEV Taskforce can support course and training opportunities through the college system for PEVs.

Aaron Milano, Energy Program Specialist, City of Durham

Aaron spoke with the Education and Outreach working group about the City of Durham's internal LEAF training program EVSE public outreach training program. The LEAF training program educates staff members on how to drive the Nissan LEAF and how to answer questions about the Nissan LEAF. The EVSE training program teaches staff members at locations that host public charging stations installed by the City of Durham or Durham County Government how to respond to questions from the public about the infrastructure and funding for infrastructure. Aaron provided the education and outreach working group with a resource the Taskforce can further develop and provide to stakeholders throughout the state. Aaron also provided general information on the benefits of taking time to educating public staff about PEVs and EVSE.

Education

The Education and Outreach Working Group defined education as the development of resources to teach key target audiences about topics related to PEVs and PEV readiness planning and implementation.

Outreach

The Education and Outreach Working Group defined outreach as the dissemination of resources developed through education to reach key target audiences related to PEVs and PEV readiness planning and implementation.

Training

The Education and Outreach working group defined training as a component of education and outreach that includes curriculum and content development for specific PEV topics for key target audiences.

Marketing

The Education and Outreach Working group defined marketing as the promotion of education and outreach initiatives, key messages and readiness activities related to PEVs.

Target Audiences

Local Governments	Key Messages	Education & Outreach	Collateral
<p>Local Governments</p> <ul style="list-style-type: none"> • Municipalities • Fleets • County Government • Elected Officials/ Political Parties 	<ul style="list-style-type: none"> • Long term cost savings (cost analysis) • Opportunities for Economic Development • Be Progressive 	<ul style="list-style-type: none"> • Emails with links and attachments • Press releases • Direct contact with key staff • Video PSAs that can run on their stations and linked to their websites • Set up at government sponsored events 	<ul style="list-style-type: none"> • E-newsletters, brochures, pamphlets • Video PSAs sent to email inboxes • Invitations to webinars • ID EV Champion (IE. Sustainability Manager or environmental planner) • Create talking points, backed up by credible sources (in laymen’s terms) • Show them how/where they can save money • Work through League of Municipalities and NC Association of County Commissioners • Newsletters, conferences, webinars, etc. • Work through NC Chapter of American Public Works Association • Fleet managers are members • Work through the 16 NC COGs to get info to chief elected officials in each region • Materials and short presentations • UNC School of Government does a lot of training to local elected officials and staff • PEV Forum for local government / seminar / conference / workshops / classes • Local Presentations • Conferences • Brown Bag Lunches • Spotlight successes from the field from first adopter communities

Regional Govern-ment/Organization	Key Messages	Education & Outreach
<ul style="list-style-type: none"> • Clean City Coalitions • State Government • Council of Govern-ments • Fleets • Transit Agencies • MPOs/RFOs • Elected Officials 	<ul style="list-style-type: none"> • PEVs are good for air quality and can help MPOs meet air quality requirements • It is time to prepare for these vehicles in our communities • North Carolina is lead- ing the way in early PEV adoption and communi- ties need to be prepared for the electric drive revolution 	<ul style="list-style-type: none"> • Press releases • Emails with links & attachments • Video PSAs sent electronically • E-newsletters, brochures, pamphlets • Displays at events • Invitation to webinars • ID a Champion who can pull in stakeholders • Find out what is important to them, then adjust your mes- sage to fit it • Tie PEVs to economic development opportunities • Brown Bag Lunches for staff or lunch and learns • Work through government associations and pitch stories to government publications • Provide workshops and classes • Present at conferences • Provide local presentations
Early Adopters	Key Messages	Education & Outreach
<ul style="list-style-type: none"> • Trend Setters • PEV Owners • Young Professionals • Environmental Enthusi-asts • Automobile Enthusi-asts 	<ul style="list-style-type: none"> • Early adopters are the best advocates for PEVs. • Consumers want to hear about their experiences with their PEV • Early adopters will have an effect on community planning for PEVs 	<ul style="list-style-type: none"> • Encourage early adoption through presentations at existing networking events with demonstrations, ride & drives and panel discussions that include PEV owners • Invite early adopters to display/set-up at local events and festivals • E-blasts to early adopters about developments in the PEV industry • Create contests or campaigns focused on PEV education dissemination • Create a series of videos for YouTube (Dispel the myth of who's driving EVs; showcase the cool technology, the fun of driving an EV, make it hip and fun) • Create an online community for local early adopters • Make it fun for early adopters, make them want to get involved with promoting PEVs • Get the information in an “enticing” package • Work through the communication channels and community events that already exist with local governments • Use social media to connect with early adopters • Provide local car dealers with pamphlets about PEVs • Create a consumer friendly website • Promote Total Cost of Ownership facts • Encourage early adopters to host driveway parties

General Public	Key Messages	Education & Outreach
<ul style="list-style-type: none"> • Generation Y and Net Generation • Second-wave Purchasers • General Consumers • Environmental Enthusiasts • General Public 	<ul style="list-style-type: none"> • PEVs are safe and high-way capable • PEVs are fun, sexy and exciting! • PEVs are a good financial investment • PEVs can accommodate a variety of lifestyles 	<ul style="list-style-type: none"> • Do outreach through social media outlets • Create a series of videos on YouTube (Dispel the myth of who's driving EVs; showcase the cool technology, the fun of driving an EV, make it hip and fun) • Purchase billboard space and radio spots to promote PEVs • Work through the communication channels and community events that already exist with local governments • Deliver the content ready to go – make it easy for them to learn about PEVs • Have PEVs at large events such as NFL games, college games and the state fair • Create a consumer based website – with FAQs and myth busters • Provide Ride and Drive opportunities • Work with the media to provide news articles on PEV ownership • Support the STEP program and the EV Challenge by connecting these programs to industry organizations who can provide support and also by promoting these programs in communities throughout North Carolina
Academia	Key Messages	Education & Outreach
<ul style="list-style-type: none"> • Universities • School fleets • Schools (K-12) • Community Colleges 	<ul style="list-style-type: none"> • Be involved and adopt PEV readiness initiatives to be progressive and a part of cutting edge technology • PEVs are a good financial investment for fleets • Get involved with training a new area of the “green” workforce • PEVs can fit into sustainability initiatives 	<ul style="list-style-type: none"> • Get on guest lecturer list in appropriate departments • Invite key speakers to present on campus • Work with professors to have speakers visit individual classes • Provide modular curricula that can be implemented into classes • Show them the cost savings through case studies • Sponsor work-day events where they can learn about what's out there, and network with others in similar positions • Show them what other schools are doing (competition) • Brown Bag Lunches or Lunch and Learns for potential campus/school champions • Work through local government associations and publications • Promote workshops and classes offered at schools • Attend conferences targeting the key audiences • Work with student governments to plan campus events • Develop Car share programs that utilize PEVs

Industry (Work Force)	Key Messages	Education & Outreach
<ul style="list-style-type: none"> •First Responders •Electrical Contractors •Maintenance Shop Workers 	<ul style="list-style-type: none"> •Be informed to be safe •The adoption of PEVs creates a new workforce opportunity •There are resources readily available 	<ul style="list-style-type: none"> •Create educational pieces on maintenance of PEVs (illustrate opportunities to broaden skill set) •Provide presentations on safety aspects and appropriate emergency techniques for Emergency First Responders, etc. •Provide short articles that can be shared through company newsletters •Work with North Carolina’s Community College system to develop a plan on how to incorporate PEV curriculum into the classrooms •Provide hands on training •Work with workforce training programs to promote programs •Coordinate and deliver train the trainer programs •Offer CEUs for courses •Work with high school automotive programs to introduce high school students to PEVs
Industry (Vehicle Related)	Key Messages	Education & Outreach
<ul style="list-style-type: none"> •Car Dealers •Mechanics •General PEV Industry 	<ul style="list-style-type: none"> •There are opportunities to make money •There are incentives and cost benefits related to purchasing and owning a PEV 	<ul style="list-style-type: none"> •Provide short articles that can be shared through company newsletters •Create a relationship with this audience and invite them to Taskforce events and meetings •Provide hands on training opportunities •Promote work with workforce training programs •Offer CEU credits for education forums •Provide articles for trade magazines •Develop fact sheets to be distributed through these audiences to the consumers •“20 reasons to buy an EV” sheet •Offer networking opportunities
Business (Real Estate & Property Management)	Key Messages	Education & Outreach
<ul style="list-style-type: none"> •Home builders •Workplace charging locations •Developers •Commercial Property/managers and landlords •Real Estate agencies 	<ul style="list-style-type: none"> •Pre-plan for the electrical load •Set homes apart in the market with residential installs. It is an easy upgrade to a new home •Prepare current sites for future installations •PEV owners promote economic development 	<ul style="list-style-type: none"> •Create flyers •Present or reserve booth space at the Southern Ideal Home show •Parade of Homes – house with charging station on tour •Build relationships with building maintenance associations and chambers •Seminars for large real estate offices •Provide Workshops •Pitch articles in trade magazines •Host sessions at conferences •Create a webpage geared towards professionals on the NC PEV Taskforce website

Business (Economic Development)	Key Messages	Education & Outreach
<ul style="list-style-type: none"> • Better Business Bureau • Fleets • Small business owners • Tourism Boards • Rental Car Companies • Local chambers of commerce 	<ul style="list-style-type: none"> • Promote green and sustainable business practices • There is an opportunity for economic development • Support the NC PEV Industry 	<ul style="list-style-type: none"> • Develop talking points for them – help them capture what is already going on and enhance it with PEV data • Provide true cost of ownership analysis • Provide workshops • Pitch articles for Trade magazines • Host sessions at conferences • Create a webpage geared towards professionals
Media	Key Messages	Education & Outreach
<ul style="list-style-type: none"> • Television • Social Media • Newspapers • Radio 	<ul style="list-style-type: none"> • Support PEVs and alternate forms of transportation • Tell your audience about potential savings with driving a PEV • NC is a national hot spot for early PEV adoption • PEV planning initiatives are real and are supported by funding programs • PEVs are fun to drive • No gas! • PEVs are a viable option for NC drivers 	<ul style="list-style-type: none"> • Invite the media to all NC PEV taskforce events and to all community events • Invite to events, such as ribbon cuttings • Invite to participate in a media ride and drive event • Invite TV personalities to moderate panels on PEVs • Invite bloggers to be a part of the conversation • Pitch stories – tell them the story we want them to tell • Develop a media sponsor package to select and exclusive sponsor over the next 2 years • Who can offer the most coverage and support (across the state) • Distribute Press releases for all major events • Provide good and accurate Information on website • Involve media in planning activities • Invite early adopters to reach out to their local media outlets to discuss driving a PEV

Recommendations

The following recommendations were derived from the expert presentations to the Education and Outreach Working Group and the discussions that followed during and after meetings.

Table 11. Education & Outreach Working Group Recommendations				
	Recommendation	Examples	Time Frame*	Priority Level**
R.1	Develop and provide resources to help local community champions promote PEVs and create opportunities to engage community champions with the general public to provide awareness of driving PEVs	Promote Driveway party kits, organize quarterly meet-ups with drivers, create a PEV ambassador program, develop a test drive kit	On-going	Medium
R.2	Engage colleges and universities in PEV readiness planning initiatives and support them in developing and promoting technical training courses and first responder trainings	Invite leaders in the college system to join the taskforce or invite them to college education specific meetings, work directly with colleges currently offering PEV technical training courses implement a train the trainer format	Mid-Term	High
R.3	Engage major media outlets in PEV readiness planning and implementation initiatives in efforts to provide the general public with accurate and positive information about PEVs	Media Ride and Drive events, pitch stories to the media, create a method to fact check the media, encourage PEV drivers to speak with the media about their driving experiences	On-going	High
R.4	Develop a public awareness campaign that designates North Carolina communities as PEV ready communities to encourage communities to participate in planning initiatives and to promote PEVs	Designate communities as :PEV friendly communities with signage	Short-Term	Low
R.5	Develop training materials that will assist organizations that add PEVs to their fleets and/or install infrastructure in teaching their staff members about PEVs, EVSE, best driving practices for PEVs and how to answer questions related to PEVs	Expand on and generalize the City of Durham and the City of Charlotte's training programs	Short-Term	Low
R.6	Engage fleet managers in PEV readiness planning activities and educate fleet managers on the benefits of adding PEVs to vehicle fleets	Participate in fleet conferences, host a fleet forum in communities, create a handout that explains the benefits of adding PEVs to fleet, research current fleet programs that utilize PEVs and present a case study	Mid-Term	Medium
R.7	Engage fleet managers in PEV readiness planning activities and educate fleet managers on the benefits of adding PEVs to vehicle fleets	Drive the future today, Its Electric! , etc.	Mid-Term	Medium
R.8	Coordinate a state-wide PEV Awareness Day in partnership with North Carolina science museums	North Carolina PEV Awareness Week	On-going	Medium

Table 11. Education & Outreach Working Group Recommendations

R.9	Coordinate a state-wide PEV Awareness Week in partnership with North Carolina science museums	Create a website similar to Drive Colorado	Short-term	Medium
R.10	Create a consumer based website for PEV owner discussions and for general public awareness and education	Driver YouTube videos, a twitter account that is used to promote events and dispel PEV myths, etc.	On-going	Low
R.11	Build a social media strategy that engages the NC PEV taskforce with members of the general public through popular social media outlets such as YouTube, Facebook and Twitter	Connect the STEP Program and the EV Challenge to industry leaders who can financially support the organizations' efforts, invite the programs to display at community events, support teacher workshops	On-going	Low

***Term Lengths for Recommendations**

Term	Description		
Short-Term	1 to 2 years		
Mid-Term	3 to 5 years		
Long-Term	6 to 10 years		
On-going	No set start or end time		

INCENTIVES AND ECONOMIC DEVELOPMENT



7

Authored by:

NC PEV Taskforce Incentives and Economic Development Working Group

Led by:

*NC Solar Center**/NC State University and the NC Department of Commerce*

***Authored "Plug-in Electric Vehicle Incentives Analysis and Options for NC" as part of this planning effort, included in Appendix 9*

INCENTIVES AND ECONOMIC DEVELOPMENT

Introduction to Incentives and Economic Development for PEVs

During the initial meetings of the Steering Committee in the fall of 2011, it was determined to combine the Incentives and Economic Development Working Groups. This determination was made because proposed incentives recommended by PEV related industries statewide would have a direct impact on the economic development of the state in attracting new businesses and maintaining existing companies.

NC PEV Taskforce: Incentives and Economic Development Working Group

Goals and Objectives

North Carolina is positioning itself as a national leader in PEV adoption. In order to do this successfully, we must consider carefully how to maximize the benefits and minimize the costs of PEV deployment to attract and enhance accompanying industries. The Working Group on Incentives and Economic Development used the following questions to delve into the details of implementing the above position statement:

- How can we make North Carolina become as advantageous as possible for PEV focused economic development?
- How can the environmental benefits of PEVs be used in a way that supports economic development?
- What partnerships are needed to be created with the state's existing economic development groups in order to maximize PEV related economic development?
- Where has North Carolina been successful/less successful in past economic development attempts (both related and unrelated to PEVs). What can be learned and what opportunity is there for improvement in the future?

Working Group Members

The following participants attended one or more of the seven Incentives and Economic Development Working Group meetings. See the beginning of the plan for a full list of stakeholders.

Guest Speakers

- Matt Raker, Vice President Entrepreneurship & AdvantageGreen, AdvantageWest presented on PEV related economic development activity in western North Carolina.
- Wade Fulgham, Assistant Director, Economic Development Partnership/ NC State University discussed the development of a regional Clean Tech Cluster to coalesce the many companies focused on smart grid, water efficiency and electric transportation in the Triangle region.
- Josh Anderson, Executive VP of Engineering, DesignLine Corp presented on DesignLine hybrid and electric buses including factors that influenced his company in choosing to locate to Charlotte, North Carolina.
- Stan Cross, Founder and Principal of BioWheels in Asheville, NC spoke about their unique solar powered charging stations and business model for sustainable tourism in western North Carolina.
- Julie Robinson, Director of Government Affairs, NC Sustainable Energy Association (NCSEA), gave a presentation on the legislative proposals impacting PEVs and PEV industries in the 2012 General Assembly short session. As the lead advocacy group in North Carolina for renewable energy, energy efficiency and related interests, the policy perspective provided by NCSEA is critical in understanding the landscape for PEV related incentives and economic development in North Carolina.
- Jim Poch, Director, Plug-In Carolina, presented on his organization's successful efforts to pass a tax credit for electric vehicles in South Carolina. His presentation highlighted the unforeseen challenges and many partners needed to pass legislation.

Focus Areas

North Carolina is positioning itself as a national leader in PEV adoption. In order to do this successfully, we must consider carefully how to maximize the benefits and minimize the costs of PEV deployment to attract and enhance accompanying industries. The Working Group on Incentives and Economic Development used the following questions to delve into the details of implementing the above position statement:

The following activities were established by the NC Solar Center/NCSU with stakeholder input as effective focus areas for determining the role and effectiveness of incentives.

1. Survey of fleet related contacts to assess interest in PEVs and role of incentives
2. Creation of NC PEV Related Industry list to begin determination of existing related activity
3. Survey of PEV incentives in neighboring and nearby states to assist with developing recommendations for North Carolina

Incentives

The North Carolina Solar Center/North Carolina State University completed an analysis of incentives for plug-in electric vehicles for the NC PEV Roadmap. The analysis is included as an appendix to this plan and is titled “Plug-in Electric Vehicle (PEV) Incentives Analysis and Options for North Carolina.” Key elements of this research included conducting a survey of fleet managers in North Carolina on beneficial incentives and a review of incentives adopted in states in the southeast.

Economic Development

Creation of Comprehensive List of PEV Industries

The Incentives and Economic Development Working Group determined that a useful initial exercise would be identifying what companies associated with the Plug in Electric Vehicle (PEV) industry are currently located in the state. Utilizing the resources of the Labor and Economic Analysis Division of the North Carolina Department of Commerce, and the lists compiled both by the North Carolina State University Solar Center and Advanced Energy, an initial listing of sixty (60) firms was compiled. The listing includes the name, location of the company, the activities associated with PEVs, physical location of the company, primary and sometimes secondary contacts. By distributing the initial list of companies to those industry representatives who participated in subsequent regional roundtables (see description of activities below) this list was increased to sixty-four (64) companies.

A second activity that the Incentives and Economic Development Working Group undertook was determining if other states with significant PEV industry presences had formed associations. To that end “Drive Oregon”, the statewide PEV Industry Association located in Portland, Oregon was contacted. Drive Oregon began as an Oregon Department of Commerce initiative which identified fourteen (14) PEV industries in that state. By gathering information from these firms through a series of regional roundtables over the course of a year the industries formed an association. The purposes of their association are lobbying the legislature for incentives, assistance in writing federal grant requests and attracting additional PEV related companies to the state. The Drive Oregon representative advised Incentives and Economic Development Working Group to invite the PEV industries identified in North Carolina to regional roundtables, let them meet each other, review and add to the compiled industry list, and listen to their needs without any set agenda or anticipated outcome.

From the NC PEV Industry list, the North Carolina Sustainable Energy Association (NCSEA) created a map which physically located the industries across the state. This map helps visually identify clusters of related companies and is a first step in identifying potential supply chain linkages. The largest cluster is located in the Triangle region of the state.

PEV Industry Roundtables

First PEV Industry Roundtable , July 12, 2012 Raleigh, NC

An initial PEV Roundtable was held at the AIA Headquarters Building in Raleigh on July 12, 2012. Approximately twenty companies participated. At the meeting the industry listing was distributed and the participants were asked to review and amend the list. Julie Robertson, Director of Government Affairs for NCSEA reviewed recent legislative activities in the NC General Assembly related to a proposed tax credits for PEV component manufacturers. She also urged companies to visit their elected representatives and make them aware of their presence. Discussion followed from the participants regarding the possibility of partnering with NCSEA for lobbying purposes as well as the advantages of having their own association. The companies present determined that they would like to continue future roundtables and that it would be desirable to meet at one of the companies in the Charlotte metro area in the fall.

Second PEV Industry Roundtable , September 20, 2012 Charlotte, NC

The second PEV Roundtable was held at DesignLine, Inc., the Charlotte-based, manufacturer of hybrid and electric buses. Twenty-four attendees participated in the meeting which included representatives from 16 organizations including 11 PEV related businesses. The meeting was led by the Dept. of Commerce State Energy Office and included presentations by Josh Anderson from DesignLine and Greg Davis of Petty's Garage. DesignLine is interested in partnering with in-state component manufacturers and Petty's Garage is interested in leveraging Richard Petty's racing success to raise awareness about electric vehicles. It was determined that the spring, 2013 Industry Roundtable would be held at Petty Enterprises headquarters in Randleman, NC. The meeting concluded with a tour of DesignLine's facilities.

Conclusions

An offering of incentives, to help launch the adoption of a new technology, is of paramount importance. Incentives can be defined with sunset dates and volume thresholds to limit their fiscal impact while the technology sector grows and becomes financially competitive with internal combustion vehicles. Incentives also offer the PEV industry sector a powerful tool for locating in North Carolina. Industry does well where consumers readily purchase their products. Companies also like to cluster together to help maximize efficiency of their supply chain.

Recommendations

The Incentives and Economic Development Working Group ranks vehicle rebates in the amount of \$2,000 per PEV as the highest priority to help increase adoption rates. Another incentives and Economic Development Working Group recommendation is a state PEV tax credit. Neighboring states such as South Carolina, Georgia, and Maryland offer a tax incentive of \$2,000 to \$5,000 while Tennessee offers a mail in vehicle rebate. North Carolina does not currently offer any financial incentives to support PEV adoption. However, the Analysis of PEV Incentive Options for North Carolina suggests that consumers prefer a rebate which has a more immediate financial pay-off and prioritizes removing the point of sale three percent highway use tax on electric vehicle purchases over a tax credit or vehicle rebate.

There was general consensus among the incentives and Economic Development Working Group that state incentives should be in keeping with "feebate" principles, where by fees would be increased on more polluting vehicles to offset the costs related to providing incentives for PEV adoption. Restructuring annual motor vehicle registration fees to be based on a vehicles combined fuel economy and emissions score was recommended as a way to raise funds to help offset the costs of state PEV incentives.

The following recommendations were derived from the expert presentations to the Incentives Working Group and the discussions that followed during and after meetings.

Table 12. Incentives Working Group Recommendations				
	Recommendation	Examples	Time Frame*	Priority Level**
R.1	Vehicle Rebates	Legislature	Short	High
R.2	HUT Exemption	Legislature	Short	High
R.3	Tax Credit	Legislature	Short	Med
R.4	Feebate		Short	High
R.5	PEV Implementation Council	NC PEV Taskforce	Short	High
R.6	Rental Car Tax Exemption		Med	Low
R.7	Complimentary Public Parking		Med	Low
R.8	EVSE Utility Rebate or Credit		Short	Med
R.9	EV License Plate		Short	Low

*Term Lengths for Recommendations		
	Term	Description
	Short-Term	1 to 2 years
	Mid-Term	3 to 5 years
	Long-Term	6 to 10 years
	On-going	No set start or end time

ELECTRIC UTILITIES



8

Authored by:
North Carolina's Electric Utilities and Advanced Energy

ELECTRIC UTILITIES

Overview of North Carolina

North Carolina's electric utilities include the electric power holding companies such as Duke Energy and Dominion, as well as electric cooperatives and municipally owned utilities. Each of the utilities is engaging in various PEV readiness activities to help better prepare their operations and the electric rate payers for the adoption of PEVs.

Types of Utilities

Investor Owned Utility (IOU)

"A utility company owned and operated by private investors as opposed to ownership by a governmental agency or member-customers" [for-profit]⁵⁸

There are two investor-owned utilities (IOUs) in North Carolina:

1. Duke Energy, which includes Duke Energy Carolinas and Progress Energy Carolinas
2. Dominion NC Power

Cooperative:

"A non-profit utility owned by its members"⁵⁹

North Carolina has 31 Electric Membership Corporations (EMCs)

Municipal Power Agency;

While some munis [municipalities] generate their own power, most purchase it wholesale from a larger utility⁶⁰. North Carolina has 74 Municipal and University-owned Electric Distribution Systems.

North Carolina generates its electricity from a mix of energy sources primarily including coal and nuclear with smaller amounts of hydroelectric, natural gas and other sources such as solar, wind and biomass. The U.S. Energy Information Administration indicates in the State Electricity Profile for North Carolina, released in January 2012, that North Carolina has decreased its use of coal as an energy source from 58.7 percent in 2000 to 53.8 percent in 2010⁶¹. Since the data is already two years old, it does not fully reflect the recent coal plant retirements in the state by the major utilities nor the rapidly increasing renewable energy segment. Several more coal plants are expected to be retired in the coming years to be replaced by natural gas combined cycle plants, shifting the fuel mix even further to cleaner sources.

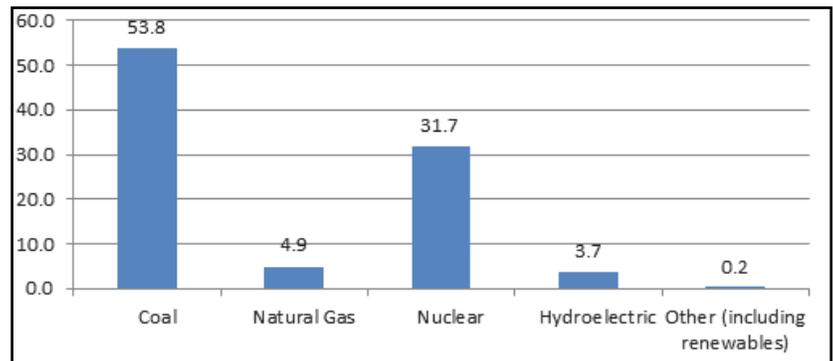


Figure 51 State Electricity Profile for North Carolina

The Union of Concerned Scientist released a report in 2012 linking the environmental benefits of electric vehicles to the grid generation mix. The report concludes that as the national sales of electric vehicles increase, a shift to cleaner sources of energy is suggested in order to maximize the reduction in net emissions⁶².

North Carolina benefits from both policy and market-driven initiatives that aim to continue the shift to cleaner electricity generation increase the use of renewable sources of energy. In 2002, the NC Clean Smokestacks Act was enacted with the support of Progress Energy and Duke Energy and has contributed to a significant reduction of emissions related to coal generation. In 2007, North Carolina became the first state in the Southeast to adopt a Renewable Energy and Energy Efficiency Portfolio Standard (REPS), which requires that electric utilities obtain a portion of their energy through renewable energy resources or energy efficiency measures⁶³.

In a market driven initiative, electric utility customers have the ability to help mitigate greenhouse gas emissions by purchasing renewable energy via NC GreenPower, an independent nonprofit organization established by the NC Utilities Commission. NC GreenPower supports electrical generation from renewable energy sources such as solar, wind, and organic matter⁶⁴. For more information on PEV adopters offsetting the energy usage by contributing to NC GreenPower, visit Chapter 4 Vehicles of this plan.

The North Carolina Utilities Commission, in 1980, founded Advanced Energy, an independent non-profit organization whose mission is to “create economic, environmental and societal benefits through innovative and market-based approaches to energy issues”⁶⁵. Advanced Energy’s Transportation Division works closely with North Carolina electric utilities on various electric transportation initiatives to help communities understand, plan for and implement electric transportation.

Description of North Carolina’s Electric Utilities

The North Carolina Electric utilities and associations have all participated in collaborative PEV readiness initiatives such as the NC PEV Taskforce and the U.S. Department of Energy’s PEV Planning grant in NC, “Plugging-in from Mountains to Sea.” Each utility and utility association has submitted a description of their operations for this plan. A matrix summarizing the utility incentives for PEV readiness can be found in Appendix 5.

Duke Energy

(Information provided by Duke Energy)
 Duke Energy is the largest electric power holding company in the United States with more than \$100 billion in total assets. Its regulated utility operations serve approximately 7.1 million electric customers located in six states in the Southeast and Midwest. Its commercial power and international business segments own and operate diverse power generation assets in North America and Latin America, including a growing portfolio of renewable energy assets in the United States. Headquartered in Charlotte, NC, Duke Energy is a Fortune 250 company traded on the New York Stock Exchange under the symbol DUK. More information about the company is available at: www.duke-energy.com

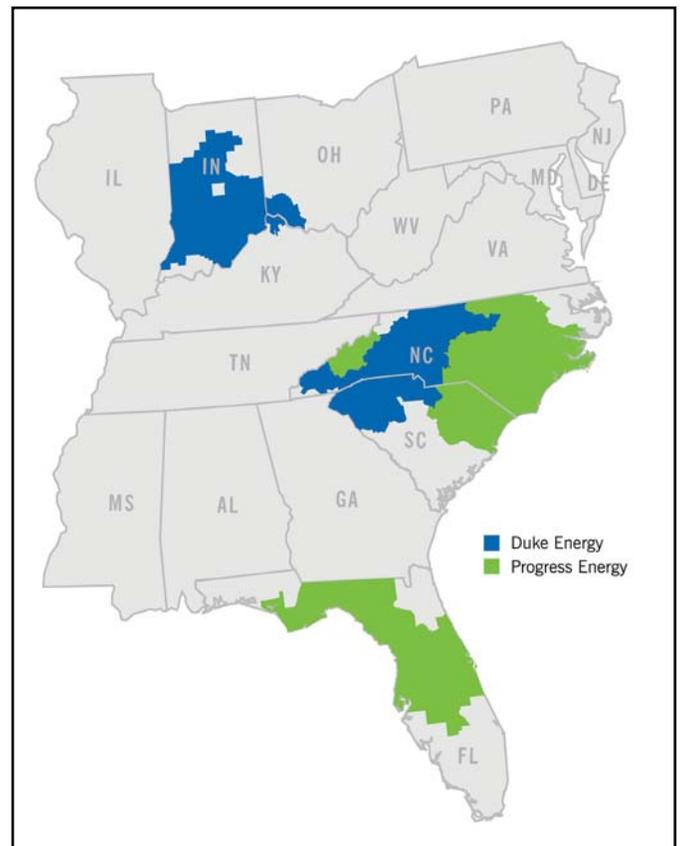


Figure 52 NC Public Power Communities Map
 Source: http://www.electricities.com/Images/NC_members_map.png

Duke Energy Carolinas

Duke Energy Carolinas owns nuclear, coal-fired, natural gas and hydroelectric generation. That diverse fuel mix provides approximately 19,500 megawatts of owned electric capacity to approximately 2.4 million customers in a 24,000-square-mile service area of North Carolina and South Carolina.

Progress Energy Carolinas

Progress Energy Carolinas, a subsidiary of Duke Energy (NYSE: DUK), provides electricity and related services to nearly 1.5 million customers in North Carolina and South Carolina. The company is headquartered in Raleigh, NC, and serves a territory encompassing more than 34,000 square miles including the cities of Raleigh, Wilmington and Asheville in North Carolina and Florence and Sumter in South Carolina. More information is available at www.progress-energy.com.

Dominion

(Information provided by Dominion)

Dominion is one of the nation's largest producers and transporters of energy, with a portfolio of approximately 27,400 megawatts of generation, 12,000 miles of natural gas transmission, gathering and storage pipeline and 6,300 miles of electric transmission lines. Dominion serves energy customers in 15 states with over 2.4 million electric customers in VA and NC, 1.3 million natural gas customers in OH & WV and 2.0 million non-regulated retail customers in 12 states.

ElectriCities

(Information provided by ElectriCities)

ElectriCities provides customer service and safety training, emergency and technical assistance, communications, government affairs and legal services to 70 municipal electric systems in the state of North Carolina. Through consolidation of these services, members save their customers the expense of administering these functions locally.

ElectriCities also provides management services to the state's two municipal Power Agencies: North Carolina Municipal Power Agency Number 1 (NCMPA1) and North Carolina Eastern Municipal Power Agency (NCEMPA). Most member cities have been in the electric business for 100 years or more.



Figure 53 NC Public Power Communities Map

Source: http://www.electricities.com/Images/NC_members_map.png

North Carolina's Electric Cooperatives

(Information provided by NC Electric Cooperatives)

North Carolina's electric cooperatives serve more than 2.5 million people across North Carolina in 93 of the state's 100 counties. The 26 electric cooperatives are private, independent and not-for-profit entities committed to providing a high standard of service to residential, commercial, industrial and agricultural customers with at-cost electric service. Each of North Carolina's electric cooperatives is governed by a board of directors elected from its membership. Members are also owners. North Carolina's electric cooperatives emphasize the importance of community involvement, integrity, accountability and innovation.

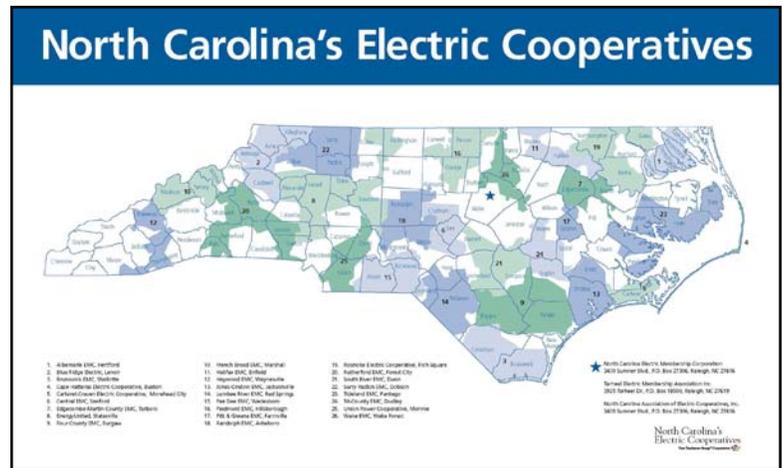


Figure 54 NC Electric Cooperatives Territory Map
<http://ncemcs.com/downloads/territoryMap.pdf>

Utility PEV Readiness Matrix

Utilities in North Carolina are involved in various activities to prepare their services and customers for PEV adoption. In order to capture the various readiness efforts of the utilities, Advanced Energy created a matrix which was completed by the utilities (Appendix 5).

The North Carolina Electric Cooperatives and ElectriCities were not included in the matrix because their memberships are comprised of many individual member utilities making it difficult to represent the various policies and programs on PEV readiness. Both the Electric Cooperatives and the ElectriCities are actively engaged in preparing for PEV adoption and they have each submitted a comprehensive list of their readiness activities which are outlined in the following section.

Public Utilities PEV Readiness Programs and Activities

In addition to the preparations listed in the matrix (Appendix 5), North Carolina electric utilities are each involved in a variety of studies, programs, and other initiatives designed to help prepare both the utilities and the residents in NC for PEVs. This section contains the readiness activities undertaken by all utility partners including the North Carolina Electric Cooperatives and ElectriCities.

Duke Energy Carolinas

(Information provided by Duke Energy Carolinas)

The information contained in this document pertains to Legacy Duke Energy Carolinas and should not be interpreted or presented as information from the combined company. Legacy Progress Energy Carolinas information is not included nor represented in this section.

Duke Energy Carolinas is currently participating in pilots to collect data that will enable us to learn about grid impacts, better understand customer charging behavior, and potentially develop PEV-related products that will appeal to PEV owning customers. Two of these pilot programs are based in North Carolina.

GM Chevy Volt EV Field Test

The purpose of the General Motors (GM) Volt Deployment Project is to evaluate the technical performance, system impacts, and user preferences associated with electric vehicle charging during normal usage of extended range electric vehicles (EREV). Technical attributes to be tested include impacts on distribution-level power delivery equipment, power quality impacts, and interoperability with customer-sited energy management systems. To achieve these objectives, Duke Energy purchased 16 Chevy Volts. Ten of these Volts were issued to Duke Energy employees with diverse commuter profiles and in some cases previously installed home energy management equipment and the other six vehicles were distributed as part of fleet pool vehicles. In addition, charging stations and necessary monitoring equipment were installed as needed to support EREV usage and collect data in accordance with the test plan.

The results of the project will be primarily technical aspects of EREV usage. These results will be made available to other business units to help project the impacts of future electric vehicle adoption.

In addition to the objectives of this project, tests will be conducted to meet the requirements of DOE Recovery Act Statement of Work (DE-FOA-0000028) which establishes information sharing requirements and some operational requirements related to EREV usage.

Charge Carolinas Project

This is an EV infrastructure pilot designed for Duke Energy to learn about residential customer charging behavior and test residential offers. This project involves 150 Duke Energy residential customers and 150 Duke Energy owned intelligent charging stations in North and South Carolina. A total of 121 customer participants are located throughout Duke Energy's North Carolina service territory as follows:

- Greater Asheville Community region 5
- Greater Charlotte region 51
- Piedmont Triad Region 18
- Research Triangle Region 41
- Other NC locations 6

In addition to these pilots, Duke Energy has collaborated with Advanced Energy since 2010 to assist with PEV community readiness efforts and partially fund the development and delivery of PEV related training courses, throughout the State.

Envision Energy Project

Another significant effort in North Carolina involving PEVs is Envision Energy Project located in the McAlpine Creek neighborhood in Charlotte, NC. McAlpine Creek is a Duke Energy test site for new technology. Residents and businesses in the area are testing a variety of components for Duke Energy, including solar panels, digital smart meters, battery storage, electric vehicles and home energy management systems. Putting the technology to use within the neighborhood allows Duke Energy to assess how various

technologies may work on a much broader scale in the future. It allows us to see understand how these technologies interact with each other, how they will integrate with the power grid, and what the customer experience will be like. The McAlpine substation serves almost 17,000 residential and commercial customers.

Fleet Vehicles

Duke Energy is also greening its vehicle fleet. We are testing and using electric vehicles in our fleet, and plan to buy more. In 2009, we made a commitment at the Clinton Global Initiative that by 2020, that all new vehicle purchases will be electric vehicles. This represents an investment of hundreds of millions of dollars and has the potential to significantly reduce fleet costs and greenhouse emissions over the next 10 years.

The Envision Center

In partnership with Advanced Energy, Duke Energy opened the Envision Center on the Centennial Campus of North Carolina State University, Raleigh, NC in 2009. The Envision Center is an interactive demonstration facility where visitors can discover how new energy technologies are transforming today's power delivery system into tomorrow's smart grid. It features modernized power equipment, a "smart" home complete with solar panels, a plug-in hybrid electric vehicle, an advanced meter display and a power delivery center with real-time monitoring capabilities. The Center promotes energy efficiency and innovation, and gives visitors an inside look at how smart grid technologies can help customers conserve energy, save money and improve the environment. Since its opening, over 2500 visitors have toured the center.

Progress Energy Carolinas

(Information provided by Progress Energy Carolinas)

The information contained in this document pertains solely to legacy Progress Energy and its operating utility Progress Energy Carolinas in the state of North Carolina. Legacy Duke Energy and the Duke Energy Carolinas operating utility information is not represented in this section.

Progress Energy Carolinas is actively engaged in a range of activities related to the research and demonstration of PEVs and related charging infrastructure. The information gathered from this work will enable us to learn about grid impacts, better understand customer charging behavior and needs, and potentially develop PEV-related products that will appeal to PEV customers.

GM Chevy Volt Demonstration

Progress Energy Carolinas is a utility partner in a grant awarded to General Motors under the American Recovery and Reinvestment Act. The automaker is utilizing the funding to help develop, demonstrate and deploy its Chevy Volt extended-range electric vehicle. Progress Energy is participating by demonstrating 12 early production Chevrolet Volts, five of which are deployed in the North Carolina territory. This expands our existing partnership and our knowledge of the technology. The vehicles join a national GM demonstration fleet of Volts with enhanced data logging capability to better understand vehicle performance and charging behavior. In addition, Progress Energy Carolinas will be completing a technology evaluation of demand response via OnStar, as well as facilitating additional research on DC fast charging and large-scale PEV charge management.

Plugged-In Carolinas Project

This is an EV charging infrastructure research project designed for Progress Energy Carolinas to learn about residential and public access electric vehicle charging infrastructure and charging behavior. This project is targeting the deployment of approximately 150 residential and 50 commercial, publicly accessible smart charging stations with Progress Energy Carolinas customers in North and South Carolina. Data collected from the stations will help us to evaluate charging needs outside the home, impact on the

grid and the costs and issues associated with installing public-access charging stations. These insights will help us as we continue to prepare for the large-scale adoption of plug-in vehicles.

Plug-in Vehicle Community Readiness Planning

Progress Energy Carolinas has collaborated with Advanced Energy since 2009 to assist with plug-in vehicle community readiness efforts and to partially fund the development and delivery of PEV-related training courses throughout the state.

Plug-in Vehicle Fleet

Progress Energy, through its Carolinas and Florida operating utilities, has deployed one of the largest plug-in vehicle fleets in the country. Specific to North Carolina, the company operates seven Chevrolet Volts, one Nissan LEAF, one prototype Ford Escape plug-in hybrid, several Toyota Plug-in Prius vehicles, and has demonstrated the Southeast's first plug-in hybrid bucket truck. The company also has working relationships with General Motors, Nissan, Ford and others to better understand vehicle technology and facilitate the integration of PEVs into the nation's electric grid.

Advanced Transportation Energy Center

Progress Energy Carolinas and NC State University announced in April 2008 the creation of the Advanced Transportation Energy Center. This innovative research center will focus on developing a lighter, cheaper and more-efficient battery and advanced charging systems for PEVs.

PLUG-IN 2011 Conference

Progress Energy Carolinas hosted and co-organized a national conference on plug-in vehicles in Raleigh, NC, in July 2011 – the first time this major industry conference was held outside California. The conference was an outstanding success, including achieving a new record for public night attendance.

Education and Outreach

Progress Energy Carolinas is a sponsor and board member of the Sustainable Transportation Education Program (STEP) at the North Carolina Solar Center. This program engages middle and high school students in learning about the transition toward electric transportation.

Dominion

(Information provided by Dominion)

PEV Utility Rates

- 01/31/2011 Filed with the Virginia State Corporation Commission an application requesting approval of two experimental and voluntary electric vehicle "EV" rate options
- 07/11/2011 The Virginia state corporation Commission issued an order granting approval of Dominion's Electric Vehicle Pilot Program and rate options
- 11/01/2012 Currently there are over 90 participants in the two experimental EV rate options

Current company owned EVs

- 3 converted Toyota Prius sedans
- 4 bucket trucks (EPRI Eaton Study), 4 additional in 2011
- 3 Chevrolet Volts (for research and interoperability assessment)
- 2 Off Road PHEV

Dominion-installed Charging Stations

- Four Vehicle charging stations were installed in New Kent County (West Bound 64 Rest Stop)
- 2 Company charging stations were installed at the Dominion Office in Fairfax VA
- 2 Company charging stations were installed at the Dominion Office in Richmond,VA
- Workplace charging stations scheduled to be installed during the 4th quarter 2012 at a Dominion office

PEV Activities

- House Bill (HB2105) was passed in VA
- Excludes EV charging service providers from state regulation prohibiting resale of electricity and from utility regulation provided that:
 - The electricity is used solely for transportation; and
 - The electricity is procured from the public utility serving the territory
- Deems provision of EV charging service to be a permitted utility activity
- Authorizes EV pilot programs and annual EV pilot cost recovery
- Extension of sunset on use of HOV lanes by clean special fuel vehicles to July 2012 (HB1432)
- Receiving regular sales updates from GM & Nissan and vehicle registration data from Virginia's

DMV

- Grid mapped Vehicle clustering locations
- Monitoring and analyzing EV clustering on our distribution system
- Completed an EPRI Study on Glebe Road (Arlington VA)
- Circuit analyses assuming different EV penetration levels & clustering effects of EV in subdivisions.
- Studied whether T&D capacity will be sufficient to supply the increased demand of PHEV charging
- Participated in Virginia Project Get Ready Initiative to educate the public about vehicle electrification and make recommendations for Virginia
- Participating in EEI Transportation Electrification Task Force
- Participated in EPRI's Electric Vehicle Infrastructure Working Council & Infrastructure Steering Committees
- Partnered with Ford on EVs (Richmond selected by Ford Motor Company as one of 19 pilot cities to launch PEVs)
- Partnered with Clean Cities Community to develop a EV Readiness Plan associated with PEVs and Charging Infrastructure
- Greater Richmond area received \$430K federal grant from US DOE
- Richmond Electric Vehicle Initiative (REVi) was formed. Key partners: VA DMME (lead), Dominion, VA Clean Cities, Richmond Regional Planning District Commission, J. Sargeant Reynolds CC, City of Richmond, Sustainable Transportation Initiative of Richmond, and VCU
- Develop plans to integrate EV policy and deployment scenarios in regional long range transportation plans
- Hold stakeholder meetings and public input sessions
- Support the updating of building codes and policies as necessary
- Develop a plan to integrate local electric permit approvals with a map/database of EVSE installations
- Advise on federal, state and local electric vehicle policies and incentives
- Develop and disseminate materials for public release
- Use relationships with municipalities, auto manufacturers, utilities, businesses, and other stakeholders to support deployment partners with planning and technical questions
- On the executive board of STIR (Sustainable Transportation Initiative of Richmond) who's goal is to ensure that the Greater Richmond Region's future transportation needs are accomplished cost-effectively. <http://www.projectstir.com/>

Customer Outreach

- 11/01/11 EV Pilot Program highlighted in Chartwell's Best Practices for Utilities and Energy Companies November newsletter
- 11/1-30/2011 Customer Connect bill insert highlighting EV Pilot Program
- 11/03/11 Participated in HYPE/STIR event at Tredegar showcasing alternative transportation in Richmond
- 11/04-05/11 Attended 2nd Annual NCCAR High School Electric Vehicle Challenge in Roanoke Rapids, NC, sponsored by Dominion Government Affairs
- 11/09/11 Meeting held with NRG to discuss partnership opportunities for their roll-out of eVgo in No. VA
- 11/15/11 Presented EV Pilot Program to the Arlington Chapter of the Association of Energy Engineers
- 11/15/11 Meeting held with Kelly Zonderwyk, Energy Program Specialist, Arlington County, to discuss EV pilot
- 12/02/11 Participated in EV charging station ribbon cutting at Fashion Centre in Pentagon City
- 12/07/11 Delivered Volt to Nuclear employee for participation in Christmas parade in Surry, VA
- 12/08/11 Served on a Panel at the Governors Transportation Conference and fielded questions regarding alternate fueling infrastructures.
- 01/09/12 Participated in the Richmond Electric Vehicle Initiative (REVI) kick-off meeting
- 01/11/12 Participated in Chartwell EV Webinar
- 01/18/12 Participated in the Sustainable Transportation in Richmond (STIR) executive committee meeting
- 01/18/12 Attended the Metro Washington Council of Governments for Electric Vehicles in Washington DC
- 01/30/12 Met with Students and University Management from UVA to discuss Dominion's involvement with EV's in VA, and the potential for a new EV charger on their campus
- 02/23/12 Attended Plugless Power Event at Virginia State Capitol
- 02/24/12 Participated in STIR executive committee meeting
- 02/29/12 Attended MWCOG EV Workgroup meeting in Washington DC
- 03/12/12 Attended Richmond Electric Vehicle Workshop (via REVi) at Innsbrook Corporate Center
- 04/12/12 Participated in STIR executive committee meeting
- 04/16/12 Attended REVi event at J. Sargeant Reynolds Community College (JSRCC) – screening of "Revenge of the Electric Car"
- 05/02/12 Attended MWCOG EV Workgroup meeting in Washington DC
- 06/12/12 Attended REVi team lead meeting at Washington Building in Richmond, VA
- 06/27/12 Attended MWCOG EV Workgroup meeting in Washington DC
- 07/12/12 Attended meeting at Richmond Regional Planning District Commission to discuss REVi
- 07/18/12 Participated in STIR Executive Committee Meeting
- 07/23/12 – 07/26/12 Attended Plug-in 2012 Conference in San Antonio, TX
- 07/29/12 – 08/01/12 Presented at Association for Commuter Transportation International Conference in Savannah, GA on REVi and EVs
- 08/20/12 Met with Arlington County Energy Manager at Lee-Harrison Shopping Center to discuss (in part) DC Fast Charging
- 08/28/12 Attended REVi planning meeting at Richmond Regional Planning District Commission
- 09/05/12 Participated in STIR Advisory Board meeting

North Carolina's Electric Cooperatives
(Information provided by NC Electric Cooperatives)

Our Support of PEV Development

The cooperatives within North Carolina, as well as the North Carolina Statewide Association, have actively participated in the promotion of the PEV market. Individually, many cooperatives have purchased electric vehicles and “wrapped” these cars in PEV promotional attire and featured them at their Annual Member meetings. Collectively, we financially support a Raleigh based organization called Advanced Energy. Dedicated research dollars are provided to assist AE’s PEV market research based initiatives, as well as develop collateral materials for our communities, coops, and their members. NCAEC also has membership with EDTA. Educational PEV support articles and editorials have been featured in our award winning publication “Carolina Country.” In addition, we have provided timely national and North Carolina specific consumer market research on PEVs to this market readiness effort. And lastly, we even have a dedicated solar power charging station for our fleet PEV.

Policies/Rates/Infrastructure Support

Not for profit electric cooperatives, by their very nature, are organizations run by their owners, the members. As the PEV market matures in each individual cooperative’s territory, the cooperatives are nimble to support the needs of the membership accordingly. No one size fits all policy will work in this diverse environment, ranging from deeply rural, to metropolitan bedroom community. As wholesale power purchasers, coops will work closely with their supplier and markets to manage and leverage distribution and energy costs as PEV demand grows.

Electricities

(Information provided by Electricities)

- 2007 – joined Plug-In Partners, a national grassroots initiative to demonstrate to automakers that a market for flexible-fuel Plug-in Hybrid Electric Vehicles (PHEV) exist today.
- 2008 – With help from an American Public Power Association grant, purchased a Toyota Prius and had it converted to a plug-in hybrid. The objective of the grant was to promote plug-in hybrids among the membership and to measure the miles per gallon performance
- In a one year project period covering 2008-2009, the NC Public Power plug in hybrid car made 46 visits to cities and ElectriCities sponsored events. Below are some specific bullet points of the cars reach:
 - 46 total visits to member cities or to ElectriCities sponsored events
 - 38 unique city visits
 - 4 cities used the car twice
 - 4 ElectriCities events where the car was displayed
 - 513,521 people attended events where the car was on display
 - There were 9 events covered by local media

The car averaged the following range of gas mileage in charge depleting/charge sustaining mode:

Fuel Economy Range	Percent of Total Miles
40-60 mpg	42%
60-80	42%
80-100	10%
100-120	4%

- 2010-present – serve as an advisor/matchmaker to member cities on issues such as charging stations and electric vehicle availability
- 2012 – organized a technical session on electric vehicles at the ElectriCities Annual Meeting including a ride and drive for members to test drive one of three electric vehicles: a Nissan LEAF, a Chevy Volt, and a Mitsubishi iMiev

Conclusions

The NC electric utilities have undertaken many initiatives to better understand and prepare for the adoption of electric vehicles. Part of the task is not only understanding the impact of electric vehicle adoption to the grid but helping the electric rate payers learn about best practices for vehicle usage.

As highlighted in this chapter, the electric utilities in the state are highly engaged in PEV preparedness. Notable trends include active engagement with collaborative efforts and rate payers, research-based studies, and contributions and recognition on a national scale.

IMPLEMENTATION



9

IMPLEMENTATION

The NC PEV Taskforce will monitor implementation of the NC PEV Roadmap and will work with stakeholders to spread awareness and encourage implementation. As mentioned at the beginning of this plan, the NC PEV Roadmap is not being adopted by a decision making body and is intended to serve as a guide to prepare the state for integration of electric vehicles.

Audiences for the Roadmap include:

- State, regional, and local governments and elected officials
- Academia, including universities, colleges, community colleges and K-12 programs
- PEV industries and industry associations
- Non-profits, research and consulting industries
- Civic, environmental and advocacy groups
- Businesses and Industries
- General public

The Taskforce will monitor implementation actions through continued engagement with local stakeholders and promoting plan awareness. Stakeholders in North Carolina and other locations are encouraged to review and replicate this plan to help boost PEV readiness activities in their locations, as these plans are intended to be both publicly releasable and replicable.

Recommendations Matrix

Each working group of the taskforce produced a set of recommendations for implementation of the Roadmap. The individual recommendations are included at the end of each section of this plan and have been compiled in a “recommendation matrix” included in Appendix 2. This recommendation matrix can be used as a high level guide for the Taskforce and NC stakeholders to move towards plug-in electric vehicle readiness.

Each recommendation has been designated a priority level and time frame for implementation. The NC PEV Taskforce will monitor NC PEV readiness activities through the year and encourage stakeholders to implement recommendations where possible. To gauge progress and document implementation actions, the Taskforce will complete a yearly report at the end of each year, which will document any efforts towards implementation. It is recommended for the Taskforce to reevaluate the recommendations after a three year period and consider updates and revisions if necessary.

Plan Awareness

The NC PEV Taskforce and its members will be the primary drivers behind creating awareness of the NC PEV Roadmap. There are several ways that the Taskforce will undertake plan awareness:

NC PEV Taskforce Meetings and Webinars

- The Taskforce will utilize the March 2013 Taskforce meeting primarily as a way to build stakeholder awareness of the plan.
- Regular webinars will highlight local and national efforts in PEV readiness and showcase portions of the plan.

Resolutions of Support

Partners of the NC PEV Readiness Initiative: Plugging in from Mountains to Sea will be asking regional stakeholders to pass resolutions of support for the NC PEV Roadmap and associated Community PEV Readiness Plans in the Asheville, Charlotte, Piedmont Triad and Triangle regions.

Conclusions

North Carolina is well positioned to see an accelerated integration of plug-in electric vehicles. The NC PEV Roadmap is the first state-wide plan focused on electric vehicle readiness. The planning process involved project partners documenting existing conditions and providing recommendations for additional readiness activities. Documentation of existing conditions was a valuable exercise, which helped to validate early assumptions made for previous readiness efforts. For example, the areas with the most charging stations corresponded with the highest numbers of registered plug-in electric vehicles.

Now that North Carolina has established a baseline and provided guidance for moving forward, future readiness efforts can take a more structured and streamlined approach. There are still many barriers that need to be address such as standardized permitting processes in rural and bedroom communities, and education and training opportunities for key audiences such as first responders and auto technicians. Moving forward the Taskforce can choose priority topics to work on implementing to keep momentum high.

The North Carolina PEV Taskforce will continue to serve as a means for collaboration on plug-in electric vehicle readiness efforts. Next steps will include reaching out to key communities outside of the initial PEV readiness planning areas of Asheville, Charlotte, Piedmont Triad and the Triangle. The Taskforce will encourage additional communities to utilize the resources provided through the NC PEV Roadmap and four Community PEV Plans to provide guidance to all communities in the state.

APPENDIX



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APPENDICES

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APPENDIX 1

COMMUNITY READINESS ASSESSMENT TABLE

Community Readiness Assessment Table

0 = Not Started
 1 = Activities Begun
 2 = Significant Progress
 3 = Completed

PEV Planning Elements	Triangle Region		Charlotte Region		Asheville Region		Triad Region	
	Initial Score	Final Score	Initial Score	Final Score	Initial Score	Final Score	Initial Score	Final Score
Documentation demonstrating a substantial partnership with relevant stakeholders, which may include:	2	2	2	2	2	2	.5	2
State and local governments	2	2	2	2	2	3	.5	2
All relevant generators and distributors of electricity and utility regulatory authorities	3	3	2	2	2	3	.5	2
As appropriate, owners and operators of regional electric power distribution and transmission facilities	1	3	1	2	2	3	0	2
Departments of public works and transportation	2	2	2	2	1	2	.5	2
Owners and operators of property that will be essential to the deployment of a sufficient level of publicly available charging infrastructure (including privately owned parking lots or structures and commercial entities with public access locations)	2	2	1	2	2	2	0	1
Plug-in electric drive vehicle manufacturers or retailers	2	3	2	3	1	3	0	1
Third-party providers (such as vendors, installers, etc.) of charging infrastructure or services	2	2	2	2	2	3	0	1
Fleet(s) that will participate in the program	2	2	2	2	1	2	.5	1
Clean Cities Coalitions	2	3	3	3	3	3	.5	1
A clear description of the role and responsibilities of each stakeholder; and a plan for continuing the engagement and participation of the stakeholders, as appropriate, throughout the implementation of the plan. This includes engagement of major fleet operators to encourage electrification of fleets such as taxis, municipal operations and delivery vehicles.	2	3	2	3	1	3	0	1
Analysis of barriers to the implementation of PEVs and infrastructure in your proposed area and a discussion of steps to reduce or eliminate the identified barriers	2	2	2	2	1	2	0	2
Current plans for plug-in electric drive vehicle deployment in the area/region covered by the plan including:	1	2	1	2	2	2	0	2
The number of plug-in electric drive vehicles anticipated to be plug-in electric drive privately owned personal vehicles; a justification should be provided for these estimates	2	3	2	3	2	3	0	3
The number of plug-in electric drive vehicles anticipated to be privately owned fleet or public fleet vehicles; a justification should be provided for these estimates	2	3	2	3	2	3	0	3
An analysis of usage patterns of vehicles	2	2	2	2	2	2	0	1

PEV Planning Elements	Triangle Region		Charlotte Region		Asheville Region		Triad Region	
	<i>Initial Score</i>	<i>Final Score</i>						
A plan for deploying residential, workplace, private, and publicly available charging infrastructure, including:	1	2	1	2	1	2	0	2
Primary and secondary potential charging locations:	1	2	1	2	1	2	0	3
An estimate of the number of consumers who will have access to private residential charging infrastructure in single-family or multifamily residences	1	2	2	2	1	2	0	1
An estimate of the number of consumers who will have access to workplace charging infrastructure	2	2	1	1	1	2	0	1
A plan for ensuring that the charging infrastructure or plug-in electric drive vehicle be able to send and receive the information needed to interact with the grid and be compatible with smart grid technologies to the extent feasible	1	1	1	1	1	1	0	1
A plan that identifies and addresses the unique challenges of installing infrastructure at multifamily residential buildings;	2	2	1	2	1	2	0	1
An estimate of the number and location of publicly and privately owned charging stations that will be publicly or commercially available	2	2	1	2	2	3	0	1
An estimate of the number and location of charging infrastructure that will be privately funded or located on private property	1	2	1	2	1	2	0	1
An estimate of the potential costs associated with EVSE deployment and potential sources of funding	1	2	2	2	1	2	.5	2
Descriptions of updated building codes (or a plan to update building codes before or during the grant period) to include charging infrastructure or dedicated circuits for charging infrastructure, as appropriate, in new construction and major renovations; EVSE must be commercially available (i.e., pre-commercial demonstration or research & development components are not desirable). "Commercially Available" EVSE is defined as equipment that is available for purchase and unrestricted operation by the general public and are fully compliant with all applicable standards and safety regulations (e.g., SAE, UL Listing or equivalent) and will be installed by a certified electrician.	1	2	1	2	1	1	0	1
Descriptions of updated construction permitting or inspection processes (or a plan to update construction permitting or inspection processes) to allow for expedited installation of charging infrastructure for purchasers of plug-in electric drive vehicles, including a permitting process that allows a vehicle purchaser to have charging infrastructure installed rapidly (24 - 48 hours is a suggested target goal for private residential applications or permit by notification).	2	2	2	2	2	2	0	1

PEV Planning Elements	Triangle Region		Charlotte Region		Asheville Region		Triad Region	
	<i>Initial Score</i>	<i>Final Score</i>						
Descriptions of updated zoning, parking rules, or other local ordinances as are necessary to facilitate the installation of publicly available charging infrastructure and to allow for access to publicly available charging infrastructure, as appropriate. Also attention should be given to compliance American with Disabilities Act if applicable.	1	2.5	1	2	1	2	0	1
A plan for effective marketing, outreach, training, and education relating to plug-in electric drive vehicles, charging services, and infrastructure; the plans should include specialized training and education necessary to ensure that vehicles and related electric charging equipment is installed, maintained, and operated in a safe and proper manner. This could include training for electric charging point users, first responders, public safety officers, inspectors, installers, and construction permitting officials in areas where electric charging is being introduced, among other target audiences.	2	2.5	2	2	1	2	0	1
An assessment and plan to communicate available or anticipated benefits or incentives for plug-in vehicle owners; and identify and establish other potential needed or desired benefits or incentives. These may include:	2	2	2	2	2	2	0	1
Rebates of part of the purchase price of the vehicle	1	2	1	2	1	2	0	1
State and federal tax incentives/credits	2	2	1	2	2	2	0	1
Reductions in sales taxes or registration fees	1	1	1	1	1	1	0	1
Rebates or reductions in the costs of permitting, purchasing, or installing home plug-in electric drive vehicle charging infrastructure	1	2	0	2	1	2	0	1
Rebates or reductions in state or local toll road access charges	1	1	0	0	0	1	0	1
Additional consumer benefits, such as preferred parking spaces or single-rider access to high occupancy vehicle lanes for plug-in electric drive vehicles	2	2	0	2	1	2	0	1
A description of utility, grid operator, or third-party charging service provider, policies and plans for accommodating the deployment of plug-in electric drive vehicles, including:	2	2	2	2	2	2	0	1
Rate structures or provisions and billing protocols for the charging of plug-in electric drive vehicles	2	2	2	2	2	2	0	1
Analysis of potential impacts to the grid	2	2	2	2	2	2	0	0
Plans to minimize the effects of charging on peak loads	2	2	2	2	2	2	0	0
A proposed plan for making widespread utility and grid upgrades	2	2	2	2	2	2	0	0
Score for Planning Elements 1-11	18.0	24.0	18.0	24.0	16.2	22.0	0.5	15.0

APPENDIX 2
TABLE OF RECOMMENDATIONS

NC PEV Roadmap Table of Recommendations

Focus Area	Recommendation	Time Frame	Priority
Vehicles	Continue to build a relationship with the NCDMV and explore how to work in complementary ways	On-going	High
	Publicize data on current and expected prevalence of NC PEVs and EVSE to demonstrate that the technology is feasible and accessible.	Short-Term	High
	Share the business case for PEV usage with public and private fleet managers among the NC Clean Cities Coalitions to increase early adopter market.	Short-Term	High
	Work with PEV dealers to create a package for prospective PEV owners that allows them to offset all of their vehicle-based electricity use with blocks of green energy.	Short-Term	High
	Work with the NCDMV to add a “plug-in” code to the fuel type tracking field at vehicle registration.	Short-Term	Medium
	Work with the NCDMV to create an online system for vehicle registration to diminish user error.	Long-Term	Medium
	Continue to engage with MPOs and other planning entities in the state to align priorities, provide mutual support, and avoid overlapping efforts.	Mid-Term	Medium
Education	Develop and provide resources to help local community champions promote PEVs and create opportunities to engage community champions with the general public to provide awareness of driving PEVs.	On-going	Medium
	Engage colleges and universities in PEV readiness planning initiatives and support them in developing and promoting technical training courses and first responder trainings.	Mid-Term	High
	Engage major media outlets in PEV readiness planning and implementation initiatives in efforts to provide the general public with accurate and positive information about PEVs.	On-going	High
	Develop a public awareness campaign that designates North Carolina communities as PEV ready communities to encourage communities to participate in planning initiatives and to promote PEVs.	Short-Term	Low
	Develop training materials that will assist organizations that add PEVs to their fleets and/or install infrastructure in teaching their staff members about PEVs, EVSE, best driving practices for PEVs and how to answer questions related to PEVs.	Short-Term	Low
	Engage fleet managers in PEV readiness planning activities and educate fleet managers on the benefits of adding PEVs to vehicle fleets.	Mid-Term	Medium
	Hire a marketing firm to create and implement a state-wide PEV awareness campaign.	Mid-Term	Medium

Focus Area	Recommendation	Time Frame	Priority
Education	Coordinate a state-wide PEV Awareness Week in partnership with North Carolina science museums.	On-going	Medium
	Create a consumer based website for PEV owner discussions and for general public awareness and education.	Short-Term	Medium
	Build a social media strategy that engages the NC PEV taskforce with members of the general public through popular social media outlets such as YouTube, Facebook and Twitter.	On-going	Low
	Support the STEP program and the EV Challenge program by connecting these programs to PEV industry leaders and by promoting these programs to schools throughout the state.	On-going	Low
Incentives	Vehicle Rebates	Short-Term	High
	HUT Exemption	Short-Term	High
	Tax Credit	Short-Term	Medium
	Feebate	Short-Term	High
	PEV Implementation Council	Short-Term	High
	Rental Car Tax Exemption	Mid-Term	Low
	Complimentary Public Parking	Mid-Term	Low
	EVSE Utility Rebate or Credit	Short-Term	Medium
Policies, Codes and Standards	EV License Plate	Short-Term	Low
	Develop state guidelines for ADA accessibility	Short-Term	High
	Provide identification signage and wayfinding signage to help locate charging stations	Short-Term	Medium
	Permitting: incorporate EVSE process into permitting process (24-48 process)	On-going	High
	Update local zoning ordinances to provide guidance for infrastructure placement	Mid-Term	Medium
	Technical Training: encourage local governments to train their permitting and inspections officials	Mid-Term	Medium
	Legislative Considerations: work with organizations to encourage PEV-related legislation	Mid-Term	Medium
Model Plans: Encourage local governments to adopt electric vehicle policies into their governing plans such as comprehensive plans, sustainability plans, strategic plans and small area plans	Mid-Term	Medium	

APPENDIX 3
NC PEV TASKFORCE FRAMING DOCUMENT

As more and more communities across the United States make the move toward electrified transportation, there is an increasing need for business, government and community leaders to get involved and serve as champions for this movement.

In 2011, the NC PEV Taskforce was established by the NC Department of Commerce and Advanced Energy. The taskforce is a collaborative partnership of key stakeholders in North Carolina. The Taskforce meets on a quarterly basis in various locations throughout North Carolina. Monthly working group meetings are held on specific focus areas covering: vehicles, infrastructure, incentives and economic development, education and outreach and policy, codes and standards. In the fall of 2011 the Taskforce was infused with funding from the U.S. Department of Energy to complete the NC PEV Readiness Initiative: Plugging In from Mountains to Sea, which will create a statewide roadmap (readiness plan) for PEV preparedness.

PEVs have multiple benefits compared to conventional vehicles. The cost of electricity as a transportation fuel ranges from 50 to 70 cents per gallon equivalent, which is significantly lower and less volatile than gasoline and diesel fuels. PEVs also produce fewer emissions and have lower environmental impacts than conventional vehicles. Using domestic electricity to fuel our vehicles also promotes national security by reducing our dependence on foreign oil.



Our Goals

1. Identify and address barriers to PEV adoption.
2. Involve existing & potential industry partners.
3. Recruit new industry.
4. Prepare N.C. to take advantage of future funding opportunities related to PEVs.
5. Create a PEV roadmap for N.C. to document Taskforce progress and recommend policy options.

Who Should Be Involved?

Legislature
 State and Local Governments
 Utilities
 Non-Government Organizations
 Private Industry and Employers
 Non-Profits
 Environmental Groups
 Vehicle Manufacturers
 Related Industry Leaders
 Universities, Community Colleges
 and Other Educational Institutions
 Economic Development Organizations
 Civic Groups

How to Get Involved?

Visit www.ncpevtaskforce.org today for more information.



Opportunities For Success

PEVs are becoming more available to North Carolina consumers. Models already available include the Nissan Leaf, the Chevy Volt and the Mitsubishi i-MiEV. Other makes and models will be available soon, including PEVs from major automakers such as Ford and Toyota as well as several low-volume manufacturers.

Statewide, charging stations are appearing in a variety of locations such as parking decks, street corners, shopping malls and grocery stores. Several of our state's major cities are leading the effort to get ready for the current roll-out of PEVs by major automakers. PEV readiness initiatives in Asheville, Charlotte, Piedmont Triad and the Triangle have all been nationally recognized for their efforts to smooth this transition to cleaner transportation technology. As it becomes easier for customers to purchase PEVs and install home charging stations, the overall number of public charging stations will also increase throughout the transportation landscape.

PEVs are generating new business opportunities. They require new automotive components, new supply channels and new ways of reaching consumers. North Carolina has the opportunity to create new jobs for citizens by removing barriers to PEV adoption and building strong relationships with PEV industry leaders. The continued effort of the NC PEV Taskforce will contribute to manufacturers' decisions to locate their facilities within North Carolina.

This vision will require coordination between a wide range of stakeholders to become reality. Several cities and communities are leading the way, but there remains a need for a statewide taskforce to address the larger issues. The primary goals of this N.C. PEV Taskforce are to increase the adoption of PEVs and create green jobs. Members of this group will answer questions, such as:

- How can N.C. attract more PEV manufacturing and research and development jobs?
- What additional industries can develop around PEVs?
- What is the best way to leverage our university research?
- How should our community colleges be involved in PEV workforce training?
- How can rural communities benefit?
- Should any state laws, policies or codes be modified or written?
- How should charging stations be deployed in major travel corridors to connect North Carolina's metro areas?
- How can the widespread adoption of PEVs in North Carolina be assured?

What's Stopping Widespread Adoption?

1. Initial cost of ownership.
2. Readily-available infrastructure.
3. "Range-anxiety" - fear of driving an electric car and becoming stranded without sufficient locations available for recharging.
4. Understanding - lack of basic understanding of PEVs, their capabilities, applications, life cycle costs and benefits.

Challenges We Face

- Positioning NC as a destination for clean energy businesses and professionals
- Coordinating efforts among multiple stakeholders for maximum impact
- Attracting automakers for vehicle introduction
- Increasing public awareness
- Decreasing PEV initial costs

Help Prepare NC for PEVS

You can help North Carolina prepare for the transition to electric transportation. Visit www.ncpevtaskforce.org for more information about PEVs and how to get involved.



The NC PEV Readiness Initiative: Plugging in from Mountains to Sea (M2S) planning project with funding provided by the U.S. Department of Energy's Clean Cities Program through Centralina Council of Governments. Partners include: Advanced Energy, Land of Sky Regional Council, NC Solar Center/NC State University, Piedmont Triad Regional Council, & Triangle J Council of Governments.

APPENDIX 4 BARRIERS AND OPPORTUNITIES

Identified Barriers and Opportunities for the Statewide Plan

Economic Development	
How can NC leverage its concentration and cluster of smart grid companies to encourage PEV related economic development?	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Incentives	Yes- Incentives and Economic Development
Supply Chain Recruitment	Yes- Research Triangle Cleantech Cluster
Technical knowhow among economic developers	Not Addressed- progress made
What types of support should be provided to emerging NC companies that want to build businesses around PEVs?	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Incentives	Yes- Incentives and Economic Development
Workforce Training	Yes- Education and Outreach
Marketing	Yes- Education and Outreach
Creating Standards	Yes- Policy, Codes and Standards
Business Support	Yes- Incentives and Economic Development
NC is a top location for SG companies, but has limited deployment of these technologies. In the PEV sector how can we ensure strong economic development as well as deployment of these technologies?	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Workforce development	Yes- Education and Outreach
Coming up with next generation technologies	Recommendations in Incentives and Economic Development
What tools would help recruit PEV related companies to NC?	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Incentives	Yes- Incentives and Economic Development
Training	Yes- Education and Outreach
Demand	Yes- Vehicles

What role can electric utilities play in the recruitment of companies to NC?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Technical Resources	Yes- Infrastructure
Rates	Yes- Incentives
Training	Yes- Utilities
Pilots	Yes- Utilities
What national/regional conferences, exhibitions, events or other venues should be targeted for the recruitment of companies and enhancement of NC's PEV brand?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Industrial Shows	Yes- Education and Outreach
Research Related Events	Yes- Education and Outreach
Trade Shows	Yes- Education and Outreach
Environmental/Sustainable Shows	Yes- Education and Outreach
Technology	Yes- Education and Outreach



Education and Outreach	
What fears, in your perception, do people have about PEVs?	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Response Categories	Yes- Education and Outreach
Range Anxiety	Partially
Unknown	No
Cost	Partially- stakeholder identified in NC are working on this topic
Battery Life	
What types of questions do you think consumers will have regarding PEVs?	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Response Categories	Yes- Education and Outreach
Cost (TCO, Battery Replacement)	Yes- Education and Outreach
Safety	Yes- Education and Outreach
Maintenance	Yes- Education and Outreach
Battery Disposal	Yes- Education and Outreach
Energy-fossil fuels	Yes- Education and Outreach
What kind of related training programs are needed regarding PEVs and related infrastructure?	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Response Categories	Yes- Education and Outreach
Consumer	Yes- Education and Outreach
Workforce: Installers, Inspectors, Fleets	Yes- Education and Outreach
What resources are needed for potential PEV related education providers (community colleges, independent consultants, etc.) to be able to provide necessary instructions?	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Response Categories	Partially- progress made in Education and Outreach
Training	Partially- progress made in Education and Outreach
Online Tools	Partially- progress made in Education and Outreach
Media	Partially- progress made in Education and Outreach
Funding	Partially- progress made in Education and Outreach
General Information	Partially- progress made in Education and Outreach
Information Sharing Opportunities	Partially- progress made in Education and Outreach



How should PEVs in NC be branded?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Energy/Petroleum Independence	Yes- Education and Outreach
Environmental	Yes- Education and Outreach
TCO Savings	Yes- Education and Outreach
Smart/Safe	Yes- Education and Outreach
What groups of people/stakeholders should be targeted by outreach materials to ensure we have the maximum amount of impact?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
State, Regional and Local Governments	Yes- Education and Outreach
Academia	Yes- Education and Outreach
Employers	Yes- Education and Outreach
Consumers	Yes- Education and Outreach
Fleets	Yes- Education and Outreach
Law Makers	Yes- Education and Outreach
Workforce	Yes- Education and Outreach

Incentives	
Why are Incentives Important?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Not all about cost, but fees also	Yes- Incentives and Economic Development
Cost, inspiring consumer confidence (categories)	Yes- Incentives and Economic Development
Psychology of Adoption	Yes- Incentives and Economic Development



What are potential barriers to putting PEV related incentives in place in NC?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Politics	Partially- Incentives and Economic Development
Money	Partially- Incentives and Economic Development
Gas Tax	Partially- Incentives and Economic Development
Perception of Value	Partially- Incentives and Economic Development
Perception that PEVs are not Fair	Partially- Incentives and Economic Development
Who are the key partners needed to develop and implement PEV incentives?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Utilities	Yes- Incentives and Economic Development
Government (Policy Makers)	Yes- Incentives and Economic Development
Employers	Yes- Incentives and Economic Development
NGOs (Think Tanks, Clean Fuels Coalitions)	Yes- Incentives and Economic Development
What role should the private sector play in providing incentives?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Marketing	Yes- Incentives and Economic Development
Revenue Stream	Yes- Incentives and Economic Development
End User	Yes- Incentives and Economic Development
Employers Incentives	Yes- Incentives and Economic Development
What are the most critical steps in establishing effective incentives for PEV adoption?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Coalitions	Yes- Incentives and Economic Development
Education	Yes- Incentives and Economic Development
Apollitical	Yes- Incentives and Economic Development
Declining Scale	Yes- Incentives and Economic Development



What types of incentives will be most successful in accelerating PEV adoption across the state?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Rebates	Yes- Incentives and Economic Development
Fleets	Yes- Incentives and Economic Development
Streamlined Processes (permitting)	Yes- Incentives and Economic Development
Incentives for Charging Stations	Yes- Incentives and Economic Development
Incentives for Charging Times	Yes- Incentives and Economic Development

Infrastructure	
As a PEV driver, what is necessary from an infrastructure standpoint to mitigate the perceived range anxiety?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Fast Charge capabilities	Partially- Infrastructure
Station mapping	Yes- Infrastructure
Planning for future charging stations	Yes- Infrastructure
Rental car/car share options	Yes- Vehicle Working Group and Community Readiness Plans
Where would public charging infrastructure be best sited? (macro level)	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Corridors- Midway points between metropolitan areas	No- See Infrastructure
Retail locations/Lodging	Yes- Infrastructure
Entertainment Venues	Yes- Infrastructure
Parking Garages	Yes- Infrastructure
Colleges/Universities	Yes- Infrastructure



What would you consider to be best practices in siting considerations?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Visibility	Yes- Infrastructure
Cost	Yes- Infrastructure
Data Management	Yes- Infrastructure
Safety	Yes- Infrastructure
Standards (Regulations)	Yes- Infrastructure
Choosing a Model	Yes- Infrastructure
What can be done to facilitate solution for those that want to have charging infrastructure installed (in residential, multi-family, fleet, and retail/public)	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Residential- new construction, inspections	Yes- Policies, Codes and Standards
Multi-family- dedicated parking for PEVs	Yes- Infrastructure
Retail/Public- ability to recover cost	Partially- Infrastructure
What are potential business models or payment systems (value propositions) to help recover the cost of infrastructure by owners?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Retail- shopping while charging	Partially- Infrastructure
Increase PEVs in NC	Partially- Infrastructure
Green Image	Partially- Infrastructure
Freeform discussion, write down whatever comes to your mind pressing issues about PEV infrastructure	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Business Model	Partially- Infrastructure
Grid Impact	Yes- Utilities
DC Fast Charge considerations	Partially- Infrastructure
Placement strategies	Yes- Infrastructure
Maintenance of Stations	Partially- Infrastructure



Policies, Codes and Standards	
What groups/organizations have an interest in shaping PEV policy for public charging?	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Response Categories	Yes- Policies, Codes and Standards
Governments	Yes- Utilities
Electric Utilities	Yes- Incentives and Economic Development
PEV Industries	Yes- Various working groups
Professional Associations	Yes- Education and Outreach
Safety Professionals	
How should consumers/inspectors/other stakeholders be able to access information on policies, codes and standards?	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Response Categories	Yes- Education and Outreach
Trainings	Yes- Education and Outreach
Grassroots	Yes- Education and Outreach
Targeted Education	Yes- Education and Outreach
Media	Yes- Education and Outreach
What types of existing policies affect PEVs in NC?	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Response Categories	Yes- Policies, Codes and Standards
Building Codes	Yes- Policies, Codes and Standards
Permitting	No
HOAs	Yes- Policies, Codes and Standards
Local Codes (zoning, enforcement)	Yes- Policies, Codes and Standards
Right of Way	No
Air Quality	
Are there any building codes and standards that should either be modified or created to cover the needs of PEV adoption?	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Response Categories	Yes- Policies, Codes and Standards
Local codes	Yes- Policies, Codes and Standards
ADA	No
Grid back loading	No
Insurance	No



What would a state-wide Americans with Disabilities Act (ADA) standard related to PEVS look like? What do we even need to know about ADA as it relates to EVs?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Education on ADA	Yes- Policies, Codes and Standards
Standardized station specifications	Yes- Policies, Codes and Standards
Standardized ADA requirements	Yes- Policies, Codes and Standards
What would be helpful in assisting local governments with the development of a streamline policy process for PEVs and charging station installers?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Look at other Champion Cities (cross communication)	Yes- Policies, Codes and Standards
Case Studies	Yes- Policies, Codes and Standards
Model Ordinances	Yes- Policies, Codes and Standards
Best practices	Yes- Policies, Codes and Standards
Information sharing	Yes- Policies, Codes and Standards

Vehicles	
What's your top concern if any about purchasing PEVs?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
No garage/rentals	Partially- Infrastructure
Safety	Yes- Education and Outreach
Range Anxiety	Yes- Education and Outreach
Standardization	Yes- Education and Outreach
Lack of Consumer Interest	Yes- Education and Outreach



What are the events that would precipitate the purchase of the PEVs (i.e. grant funding becoming available, etc)?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Government mandates	No
Tax credits	Yes- Incentives and Economic Development
Understanding technologies	Yes- Incentives and Economic Development
Sustainability policies (government and business)	Yes- Policies, Codes and Standards
What are the biggest barriers from your perspective to using PEVs?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Vehicle performance	Yes- Education and Outreach
Range Anxiety	Yes- Education and Outreach
Upfront and Maintenance Costs	Yes- Education and Outreach
Social Stigma	Yes- Education and Outreach
Unknown	Yes- Education and Outreach
What are the barriers, financial or others, to adopting PEVs?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Cost (repairs)	Yes- Education and Outreach
Education	Yes- Education and Outreach
Range	Yes- Education and Outreach
Social/Psychological	Yes- Education and Outreach
Think of who has purchased or plans to purchase PEVs. What are some characteristics and or motivators these people/organizations have in common?	
Response Categories	Was this addressed or was there a recommendation with action plan to address item? (Reference the Appropriate Section of the Plan)
Green Image	Yes- Education and Outreach
Performance and Fun Factor	Yes- Education and Outreach
Fleet maintenance	Yes- Vehicles
Oil independence	Yes- Education and Outreach



APPENDIX 5

NC UTILITY PEV READINESS MATRIX

Utility PEV Readiness Matrix

PEV Policies	Duke Energy Carolinas (information provided by Duke Energy Carolina)	Progress Energy Carolinas (information provided by Progress Energy Carolinas)	Dominion (Information provided by Dominion)
General Policies and Plans for Accommodating the Deployment of Plug-in Electric Drive Vehicles:	Duke Energy has a comprehensive internal readiness plan which includes a Power Delivery notification and circuit evaluation process, a customer service plan and internal communication plan. Duke Energy has also launched several customer and fleet pilots to evaluate various charging technologies, charging behaviors of PEV drivers and impacts to the grid.	Progress Energy Carolinas has a comprehensive internal readiness plan which includes grid impact scenario analyses, a utility notification arrangement with automakers, updated customer service guides as well as website information related to PEVs, and an internal communication and education plan. Progress Energy Carolinas has also launched several customer and fleet research projects to evaluate various charging technologies, charging behaviors of PEV drivers and impacts to the grid.	Dominion has undertaken various PEV readiness activities. The readiness efforts are outlined below.
Policies and Plans for Rate Structures or Provisions:	Duke Energy is evaluating the potential of utilizing a whole house TOU rate that would appeal to our PEV driving customers.	Progress Energy Carolinas is gathering a baseline of plug-in vehicle charging behavior from its load research project to better understand consumer charging behavior. Data from this project will allow the utility to better understand how vehicle charging may overlap with peak demand times, if additional rate structures may provide value in shifting peak energy usage, and how they may be best designed. Progress Energy Carolinas currently offers a whole house time-of-use rate which may be utilized by customers with PEVs.	Dominion has filed, received approval and is now implementing two electric vehicle pilot rate projects in its Commonwealth of Virginia service territory: Schedule 1EV – a whole house TOU EV rate Schedule EV - a dedicated Electric Vehicle only rate Both of these rates offer time of use price signals to encourage off peak vehicle charging. It is the Company's intention to offer similar EV rates in North Carolina as vehicle penetrations in our service territory warrant.
Policies and Plans for Billing Protocols for Charging of PEVs:	Duke Energy has not developed any specific policies/plans for billing protocols for charging PEVs. The utility is using its various PEV pilots to help it determine what additional policies and protocols will be needed as PEV adoption grows in the Duke Energy territories.	Progress Energy Carolinas has not developed any special policies/plans for billing protocols for charging PEVs. The utility is using its various PEV research programs to help it determine what additional policies and protocols will be needed as PEV adoption grows in the Progress Energy Carolinas territory.	See above
Policies and Plans for Analysis of Potential Impact to Grid:	Duke Energy has established a Power Delivery notification and circuit evaluation process through which circuits are evaluated as new PEV customers are added to the system. The utility has also completed a grid impact analysis to provide insight into the types of effects that PEV charging could have on various circuits and how much tolerance local grid infrastructure has to	Progress Energy Carolinas has established a notification arrangement with several major automakers and is evaluating the best solutions moving forward with greater adoption rates of plug-in vehicles. The utility has also completed grid impact scenario analysis across generation, transmission, and distribution to assess the potential	Dominion has performed various grid studies related to the potential loading impacts due to EV charging. Our studies have indicated that the distribution system impacts will be localized. Studies were performed assuming a Level 2 (3.3 kW) vehicle charging at peak using three levels of

support PEV charging before major infrastructure upgrades are needed.

impacts related to plug-in vehicles including an in-depth model analysis of a representative circuit outside Raleigh, NC. Under the expected penetration rates of PEVs and with modest charge rates, the grid impact is expected to be negligible in the near term. Local and isolated transformer upgrades may be necessary in some cases, although the number and exact location will vary depending on specific loading, vehicle density, and equipment ratings. These models and assessment studies are continually updated as new information becomes available related to PEV adoption rates, charging levels, and charging behaviors.

EV penetrations (5%, 10% and 20%). Even at the 20% penetration, only minor localized changes were required to our distribution system. At the 5% and 10% penetrations levels, most grid impacts were negligible. However, these results may vary based on location and vehicle density. Dominion will continue to collect valuable energy usage and customer charging behavior data from its EV Pilot Program. The resulting load shapes found in this study will be used to update our initial grid impact assumptions and will allow us to analyze the various scenarios to see if price signals are adequate incentives to shape charging behavior. Dominion is also gathering vehicle penetration and location data from various sources including Dominion's EV rate participants, Virginia DMV, General Motors, Nissan and Ford Motor Company. This data will allow us to locate the owners' addresses on a map and monitor the potential impacts to the distribution grid using our vehicle demand and energy usage data. The EV Pilot Program, along with efforts to collect data from the electric permitting process, will allow us to assess grid impacts and the necessity of infrastructure upgrades. Data from the OEM vehicle manufacturers will also be collected in North Carolina.

Policies and Plans to Minimize the Effects of Charging on Peak Loads:

Duke Energy currently offers a demand response program to retail and commercial customers to mitigate energy consumption during peak times. Although the utility does not currently have any policies to minimize the effects of on-peak charging, Duke Energy has implemented a number of PEV pilots to evaluate the impacts of on-peak charging and plans to test demand response offerings as part of its pilot activities.

Progress Energy Carolinas currently offers a whole house time-of-use rate for residential customers and demand response programs offered to retail and commercial customers to mitigate energy consumption during peak times. Although the utility does not currently have any policies to minimize the effects of on-peak charging for electric vehicles, Progress Energy Carolinas has implemented a charging station load research project to evaluate the impacts of PEV charging and plans to test demand response offerings as part of its research activities. Independent of rate structures, Progress Energy Carolinas actively communicates and encourages utilizing the built-in

Both of our pilot rate options are designed to encourage off-peak charging in an effort to avoid adding load to our current peak. One rate option is for EV-charging only and requires a separate meter to measure the energy usage associated with recharging. A customer can recharge his or her EV for as little as 54 cents per night for a 40-mile commute. The second rate option is a whole-house rate that relies on a single meter to measure electricity usage associated with the entire house. A customer could recharge his or her EV for as little as 51 cents per night for a 40-mile commute



capability of PEVs to charge off peak when it meets the needs of the drivers. using this rate.

Policies and Plans for Making Widespread Utility and Grid Upgrades:

Duke Energy has a number of elements in its Power Delivery Strategic Plan to support widespread utility and grid upgrades. These items include redesign studies of underground systems, continued implementation of its 3 year capital plan, policies/procedures to identify reliability needs of public infrastructure, and implementation of facilities rating tools and procedures. Additionally, Duke Energy is investing several million dollars in new metering and distribution management technology to modernize its grid.

Progress Energy Carolinas is actively engaged in research and demonstration projects in order to better understand the potential impact of widespread adoption of electric vehicles on the grid and how future policies may be adjusted. Near term, the impact is expected to be minimal and readily managed utilizing the existing line extension and service upgrade policies that would apply to other new load sources. Progress Energy Carolinas is also working with stakeholders to improve the utility notification process and continues to educate and encourage customers on the preferred times to charge to lessen any potential grid infrastructure concerns.

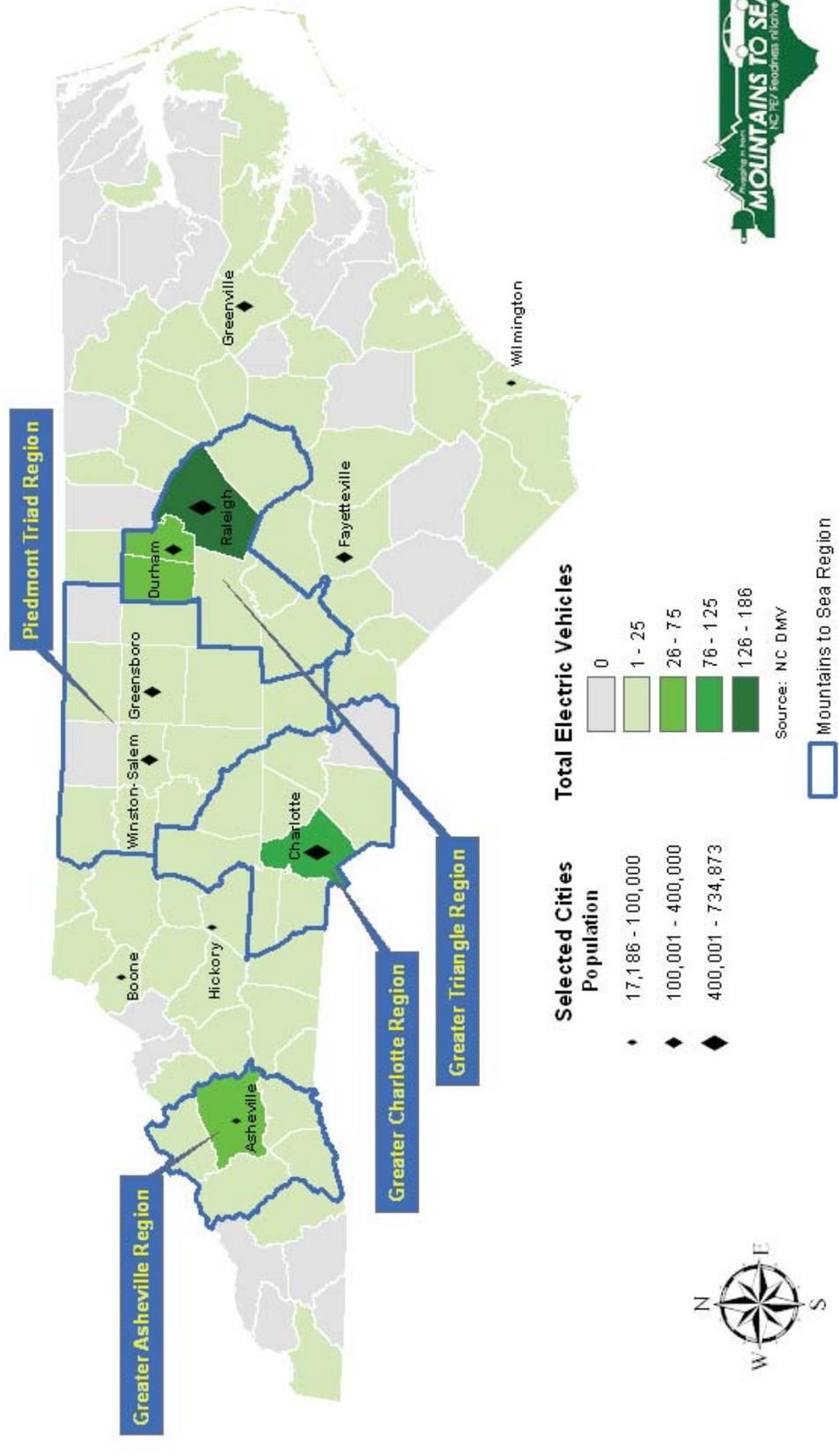
PEV charging will affect each customer location on our grid differently due to varying loading and infrastructure considerations. For example, older residential areas may be more likely to require upgrades, but even this is speculative. Also, the need for upgrades is highly dependent on the clustering effect of EV penetration. EVs spread evenly throughout a residential neighborhood are less likely to impact the Company's distribution system than heavily saturated areas. Although we cannot make generalizations regarding the impacts of EV charging on distribution infrastructure, we will emphasize to our customers the importance of notification before the installation of any EVSE. Prior notification will help the Company determine the necessity of any upgrades so the appropriate fixes are in place. Even outside the context of the TOU rates, Dominion will encourage EV owners to charge off-peak in order to lessen any potential infrastructure issues.



APPENDIX 6 MAPS

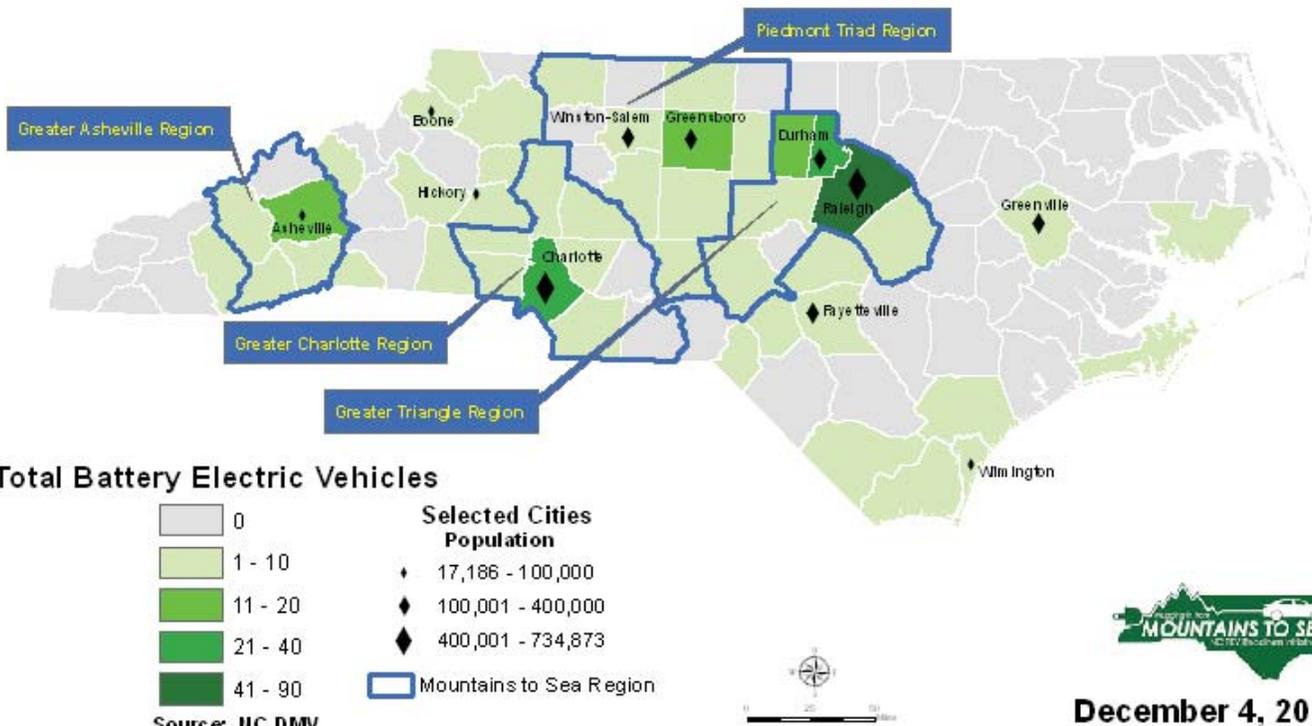
Registered Plug-in Electric Vehicles in North Carolina by County

August 2012

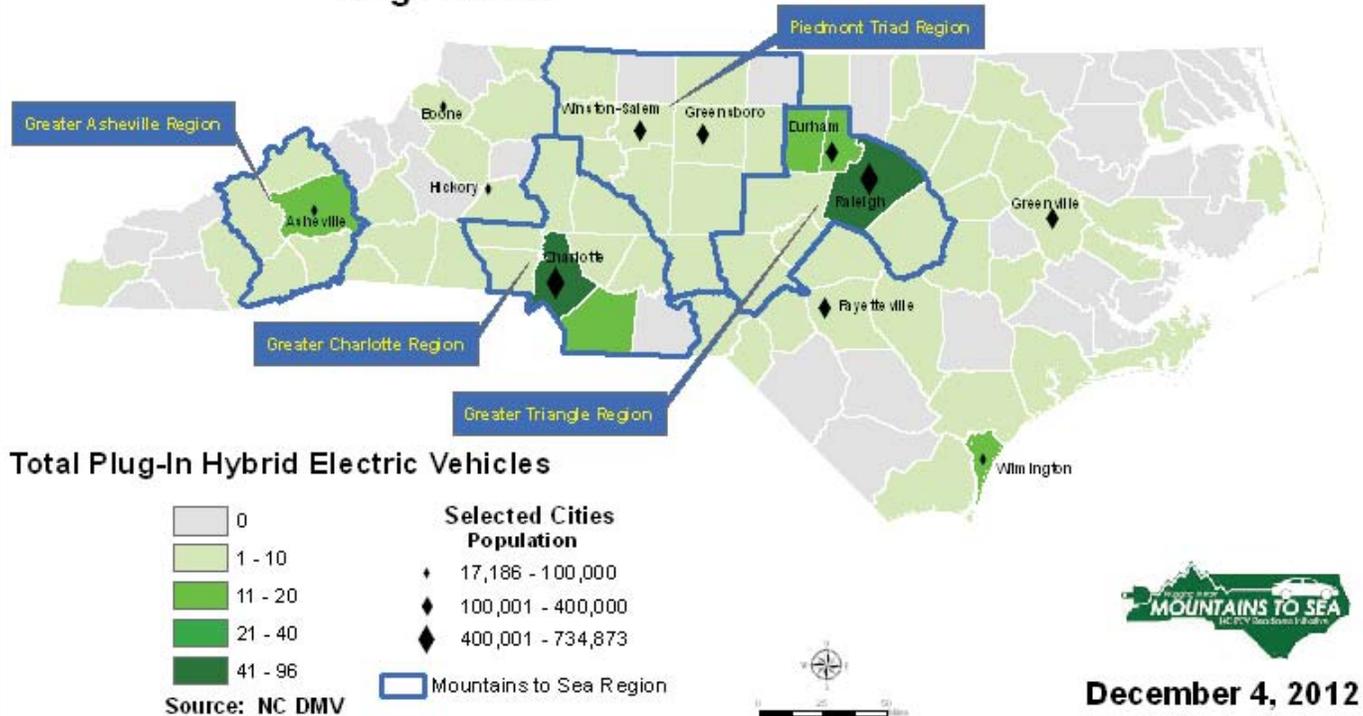


December 4, 2012

Registered Battery Electric Vehicles in North Carolina by County August 2012

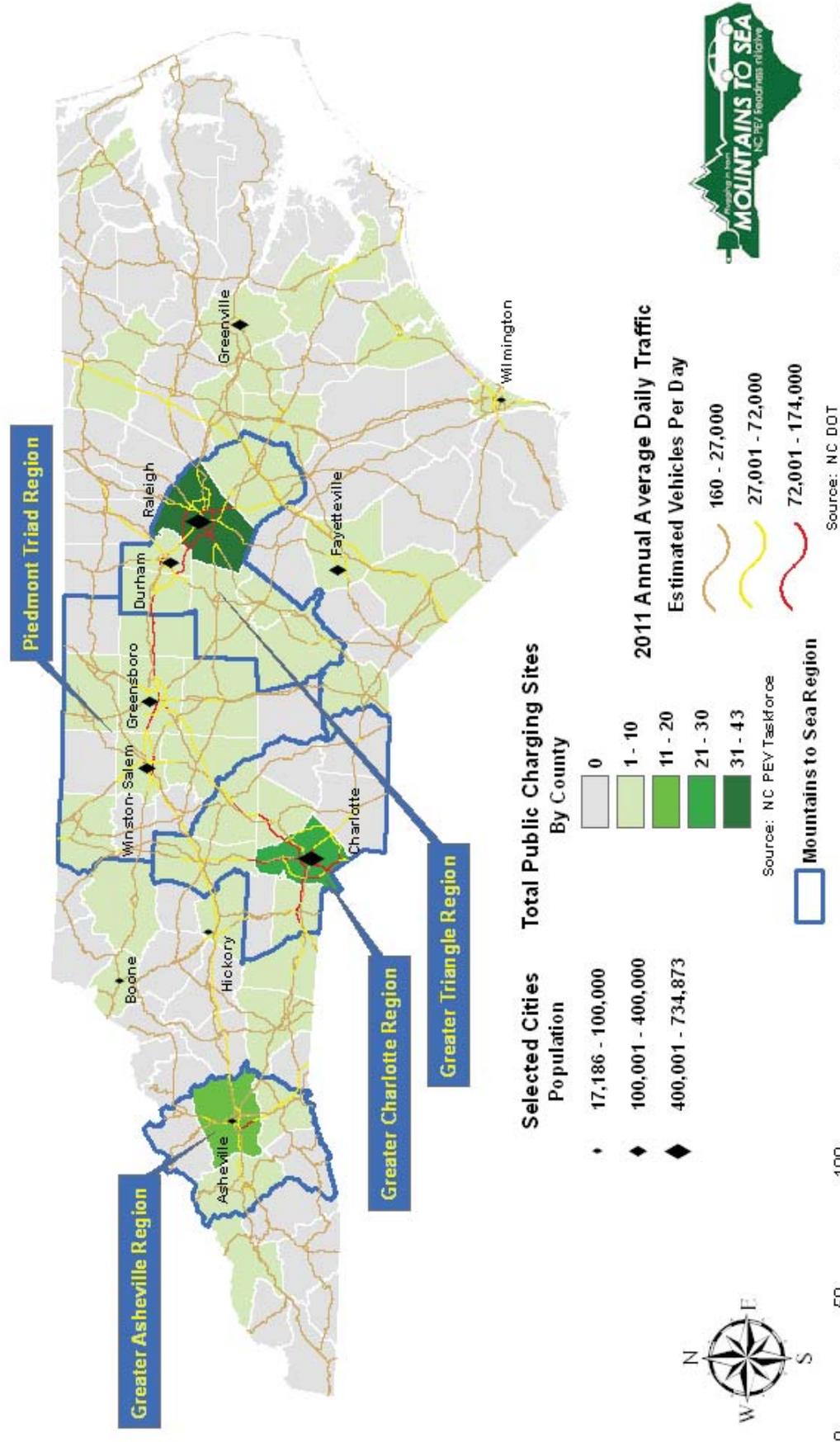


Registered Plug-In Hybrid Electric Vehicles in North Carolina by County August 2012



Public Charging Sites in North Carolina by County

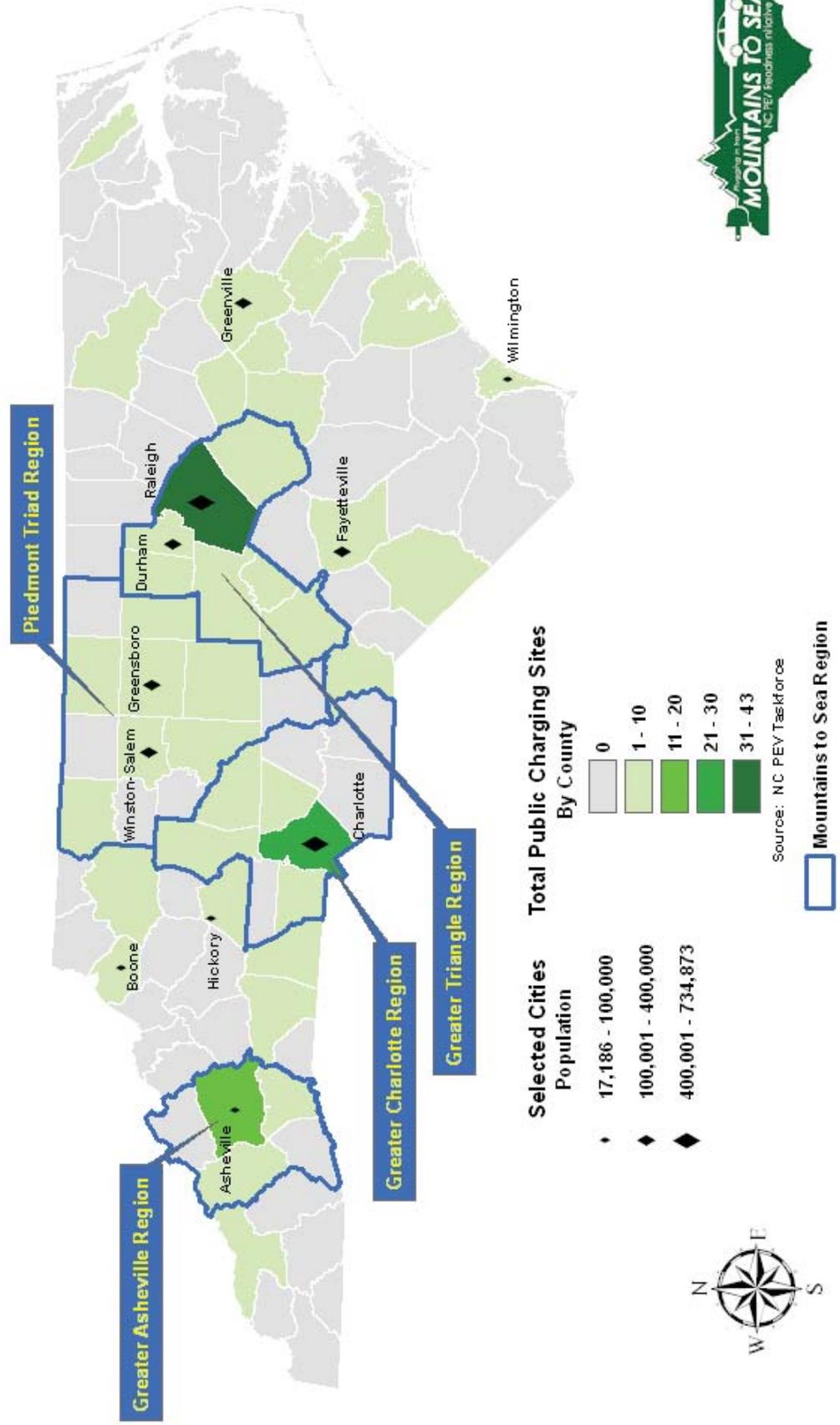
August 2012



December 4, 2012

Public Charging Sites in North Carolina by County

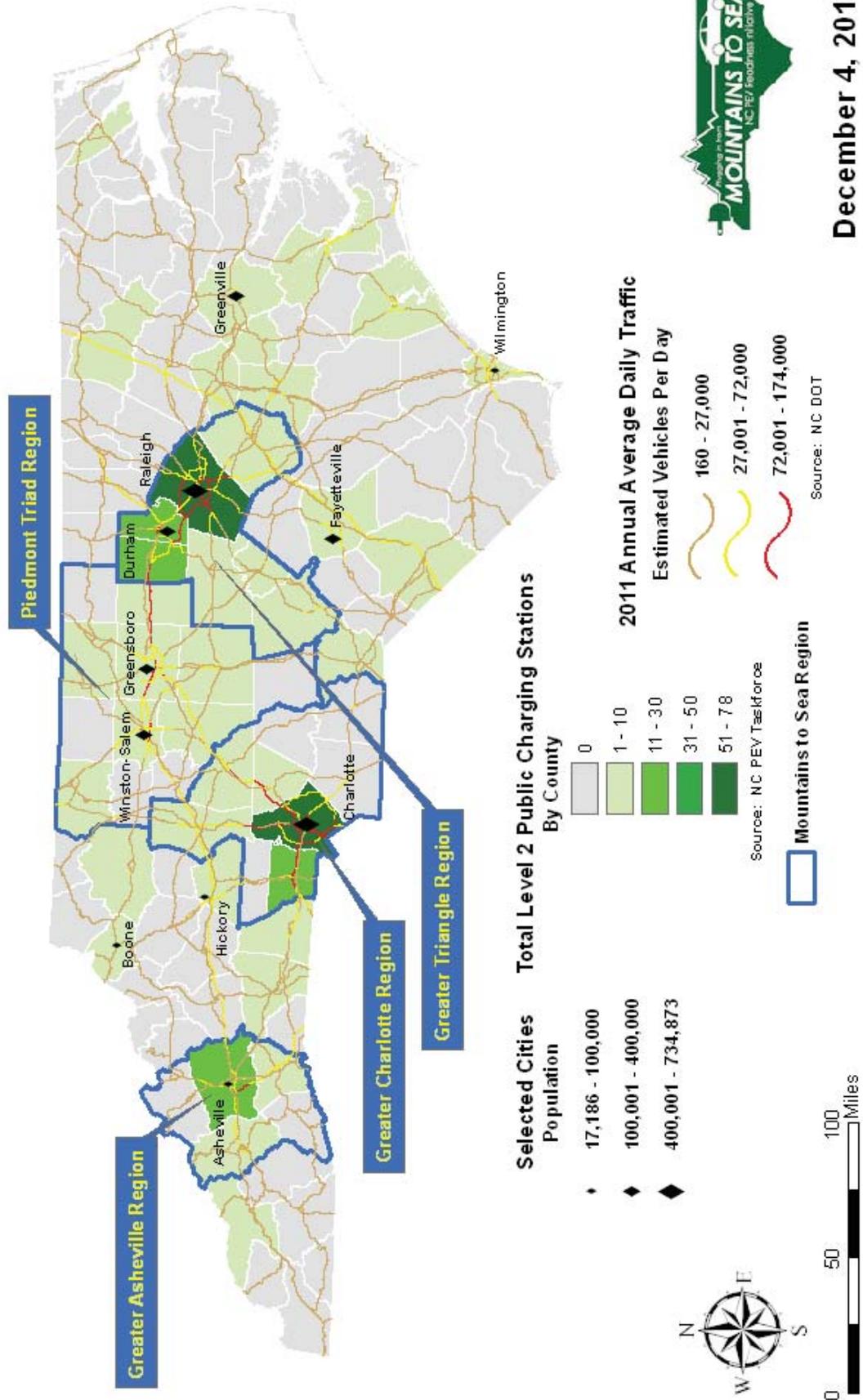
August 2012



December 4, 2012

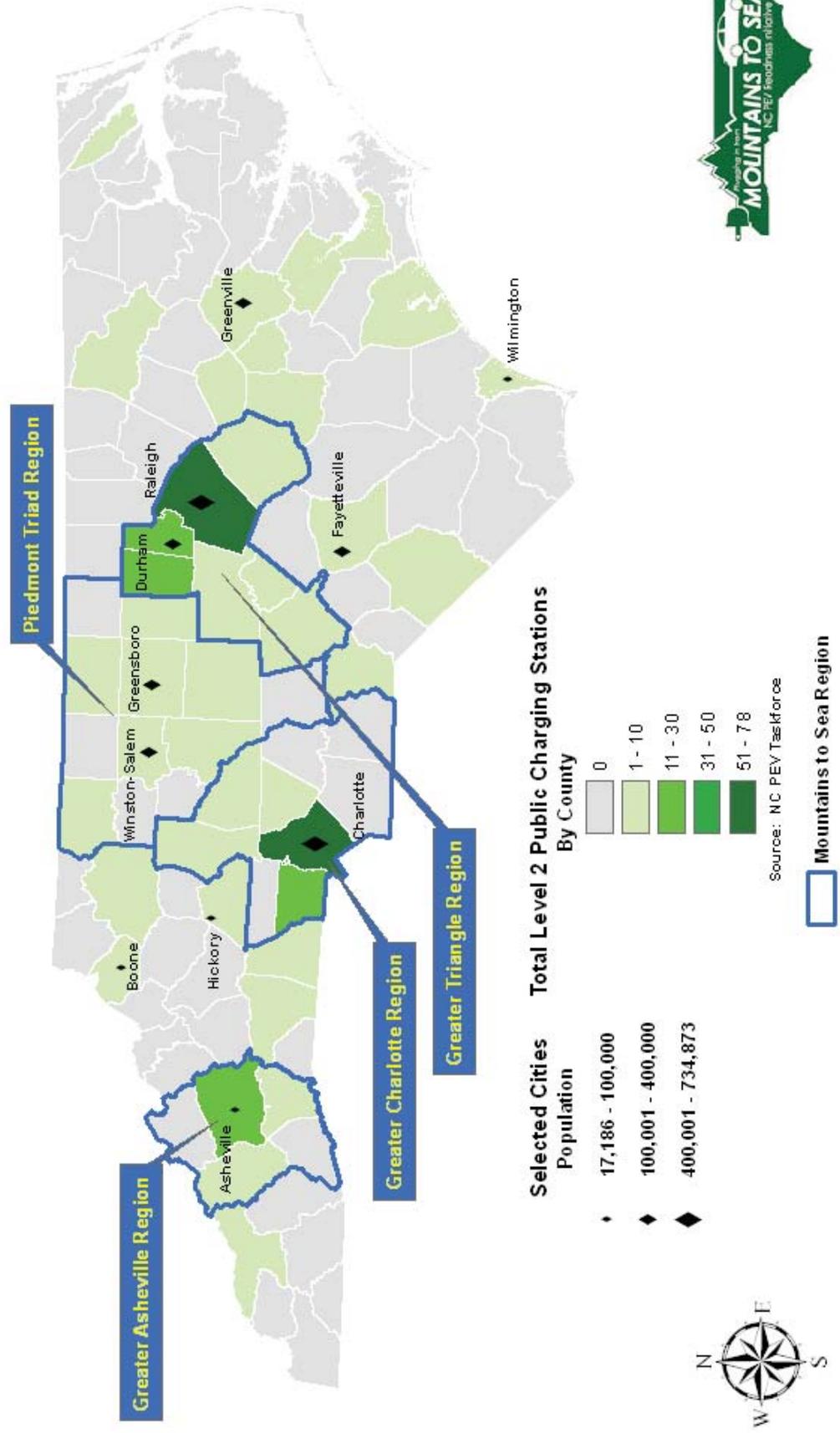
Level 2 Public Charging Stations in North Carolina by County

August 2012



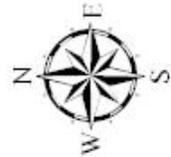
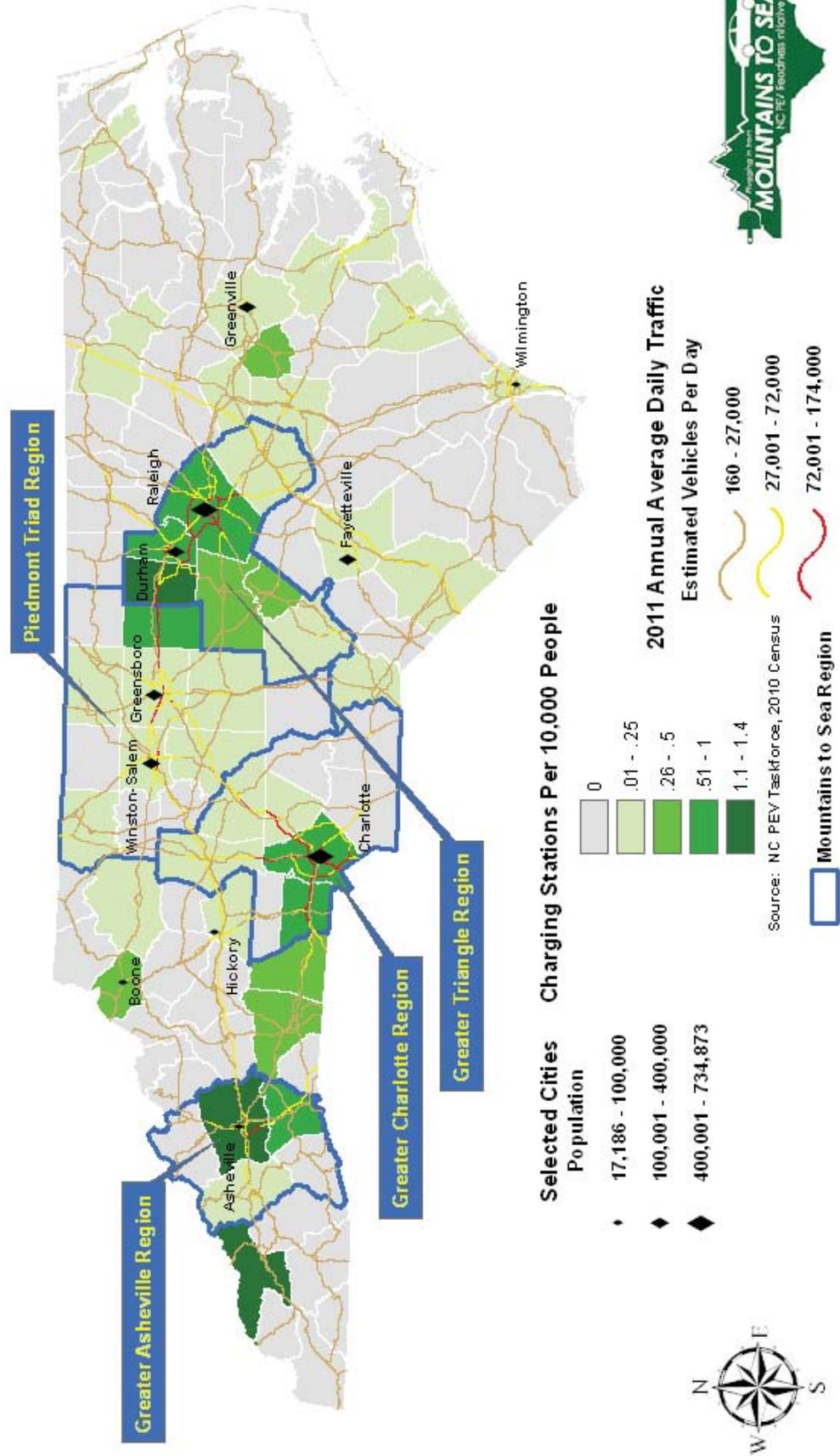
December 4, 2012

Level 2 Public Charging Stations in North Carolina by County August 2012



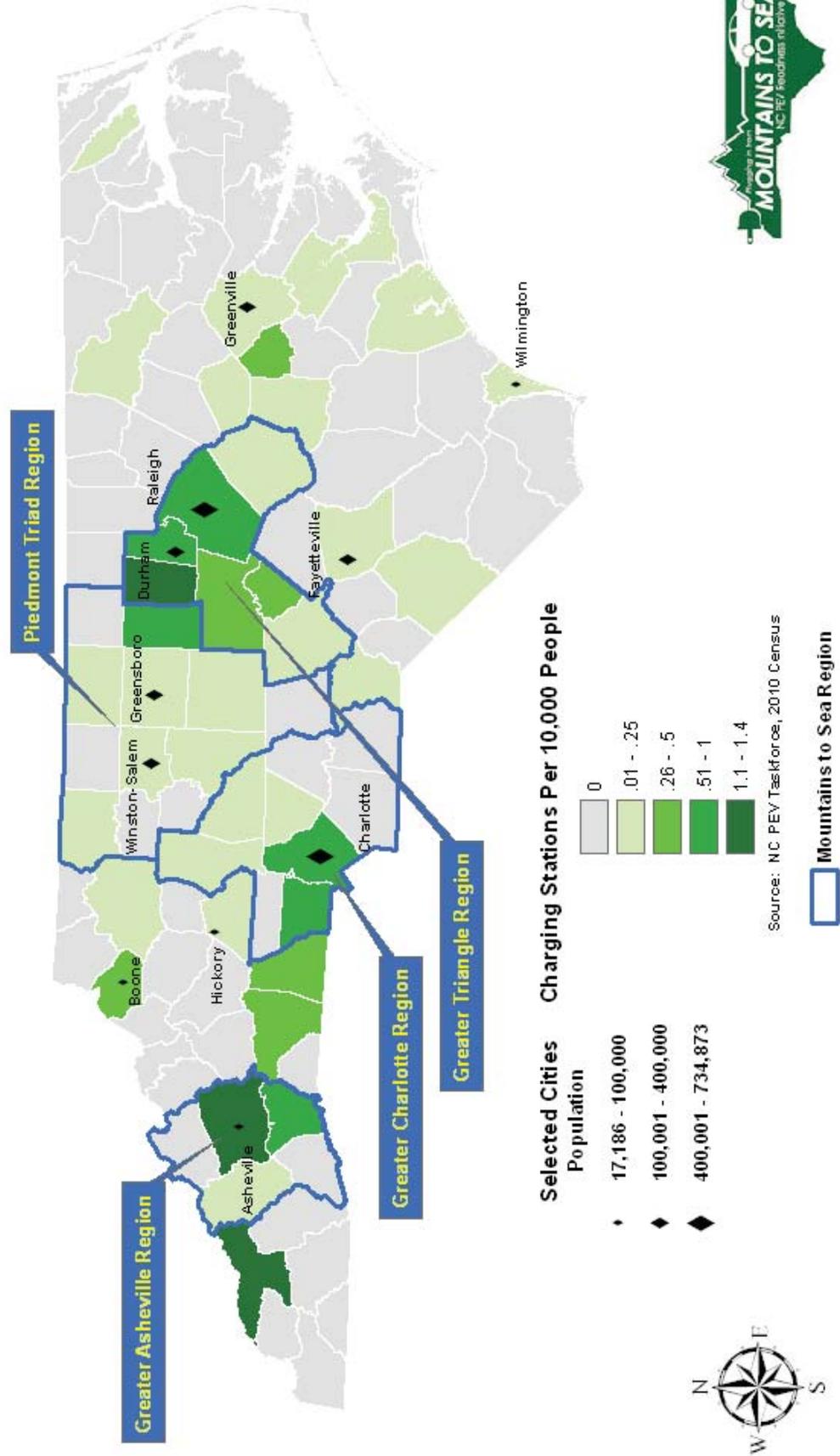
December 4, 2012

Level 2 Public Charging Stations Per 10,000 People in North Carolina by County August 2012



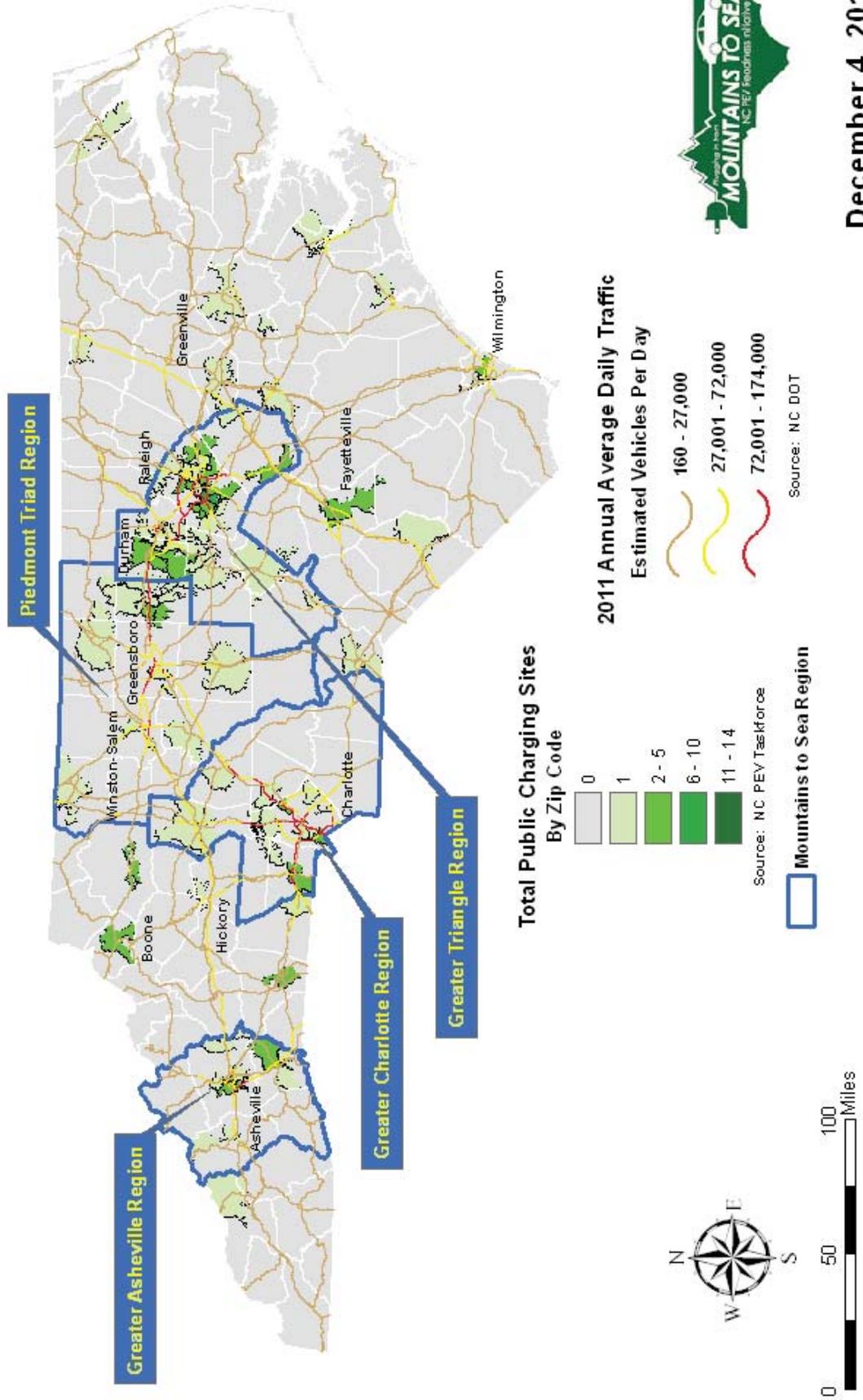
December 4, 2012

Level 2 Public Charging Stations Per 10,000 People in North Carolina by County August 2012

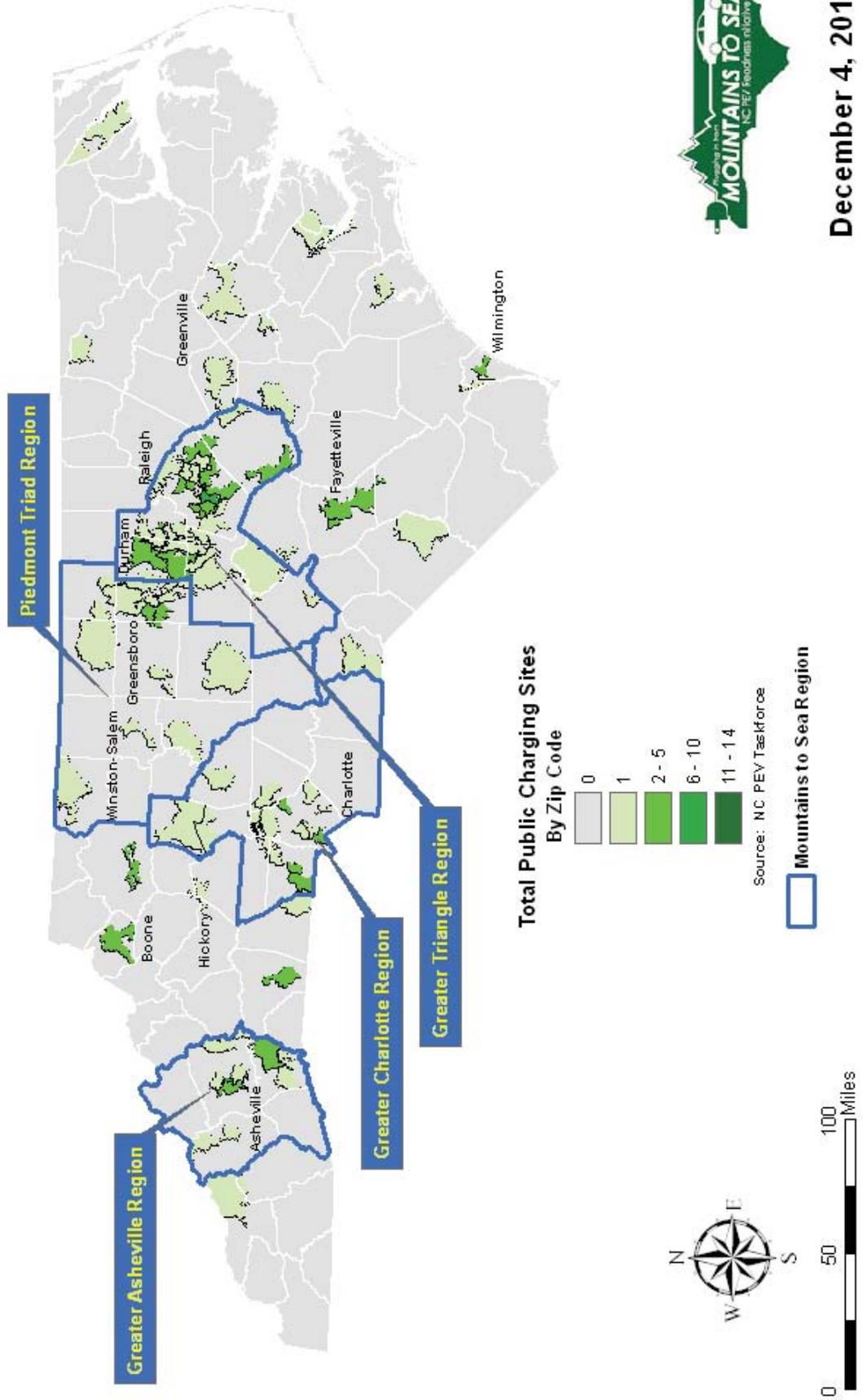


December 4, 2012

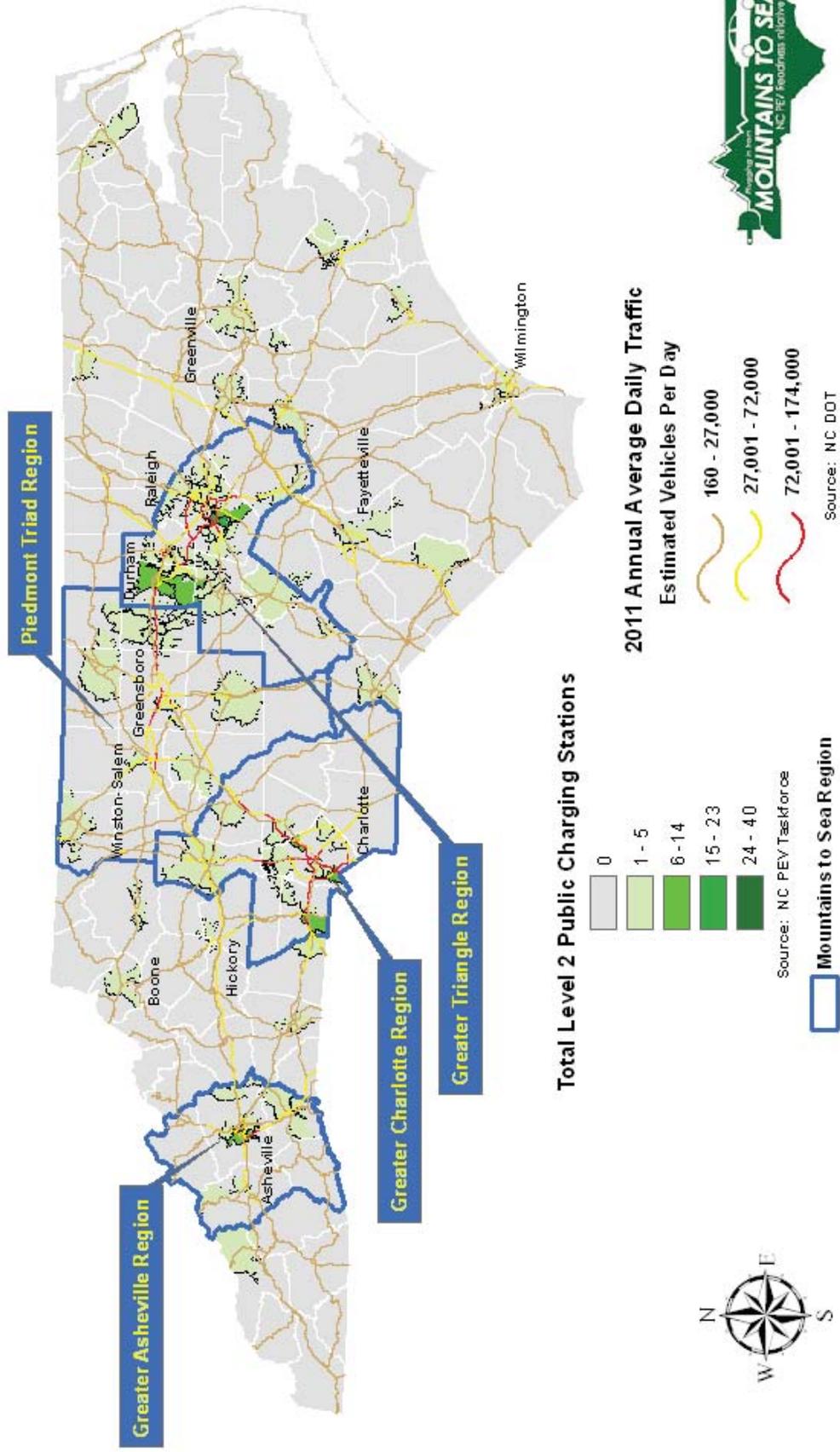
Public Charging Sites in North Carolina by Zip Code August 2012



Public Charging Sites in North Carolina by Zip Code August 2012

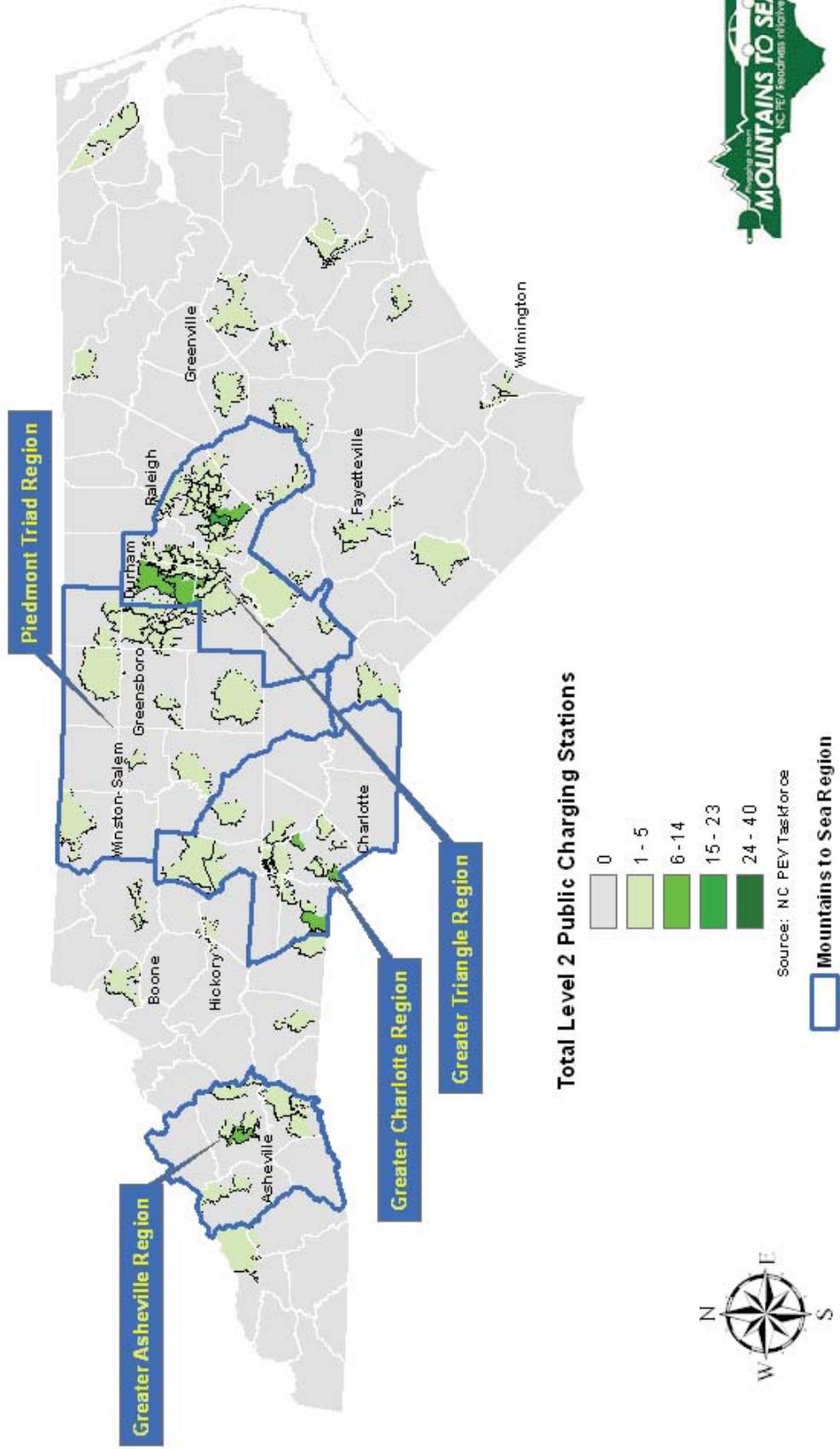


Level 2 Public Charging Stations in North Carolina by Zip Code August 2012



December 4, 2012

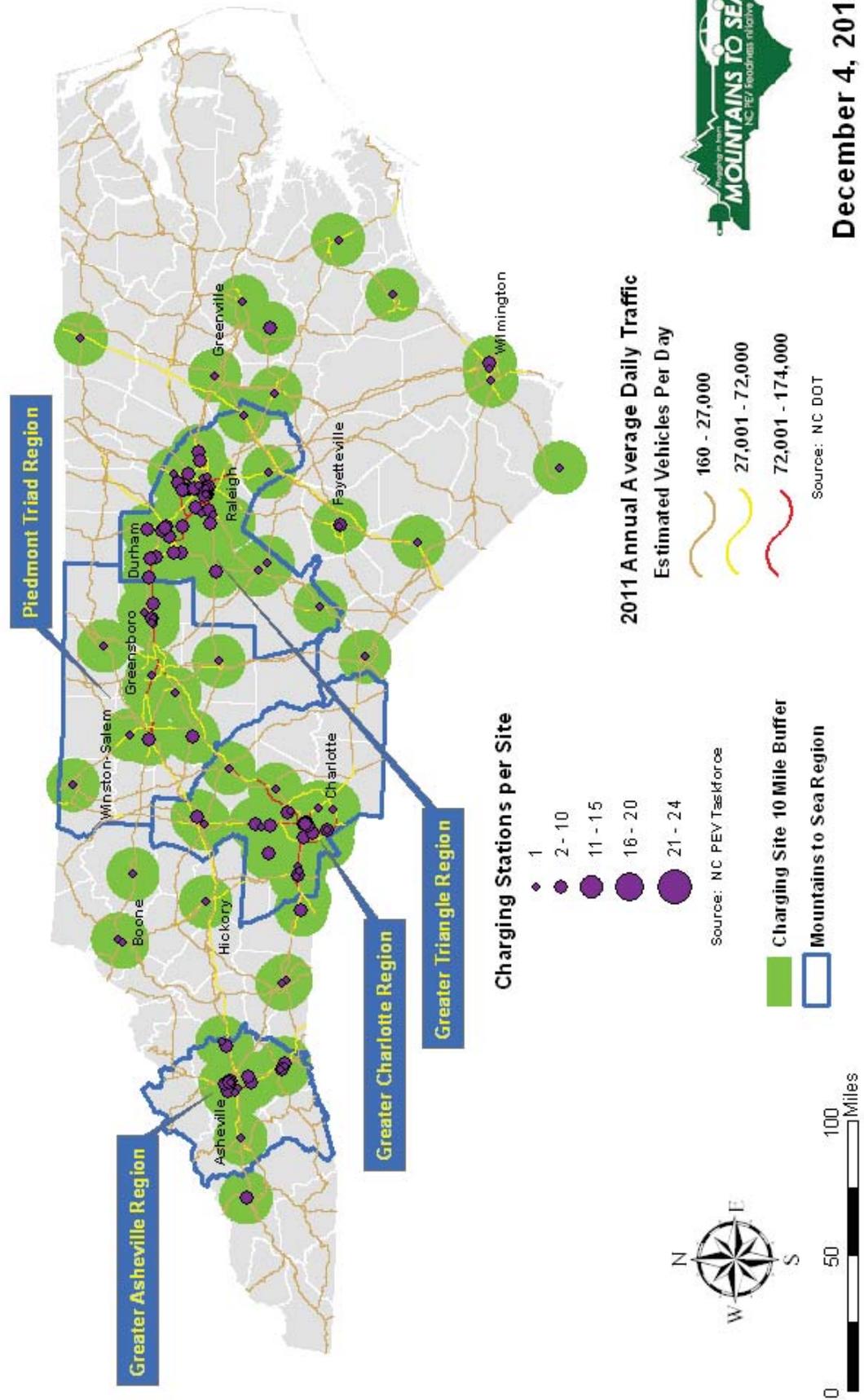
Level 2 Public Charging Stations in North Carolina by Zip Code August 2012



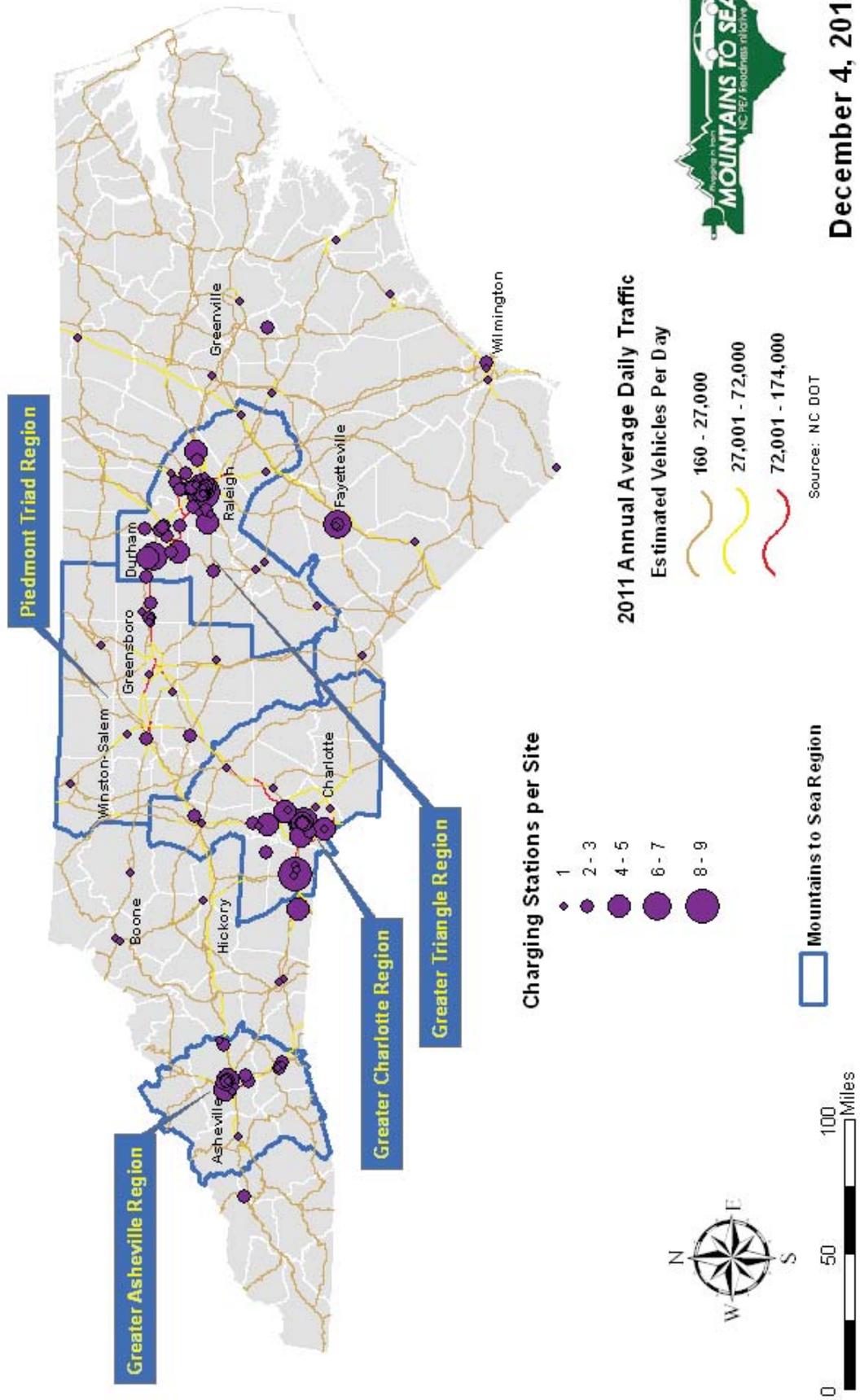
December 4, 2012

Public Charging Sites With 10 Mile Buffer

in North Carolina
August 2012

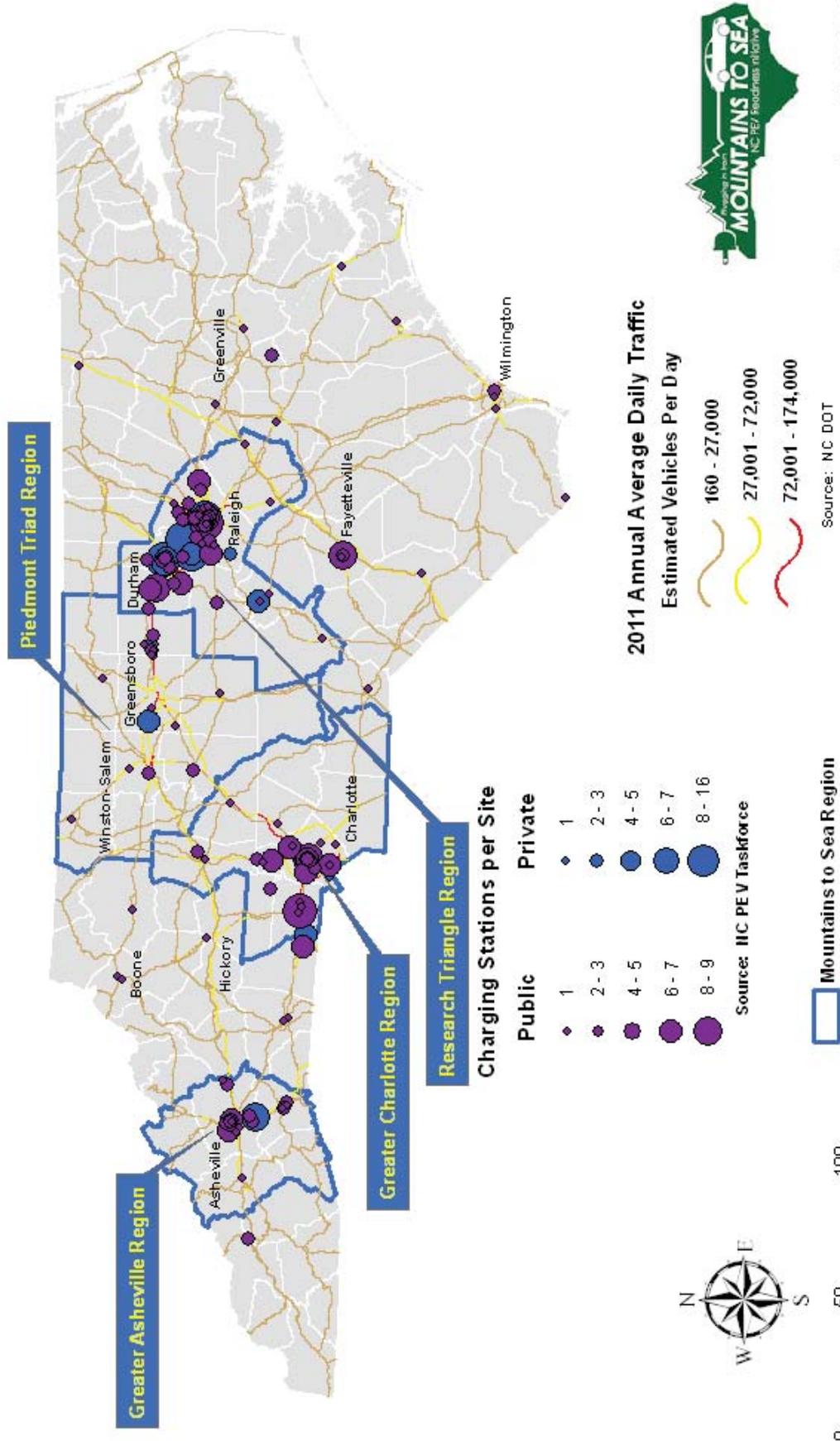


Public Charging Sites in North Carolina August 2012

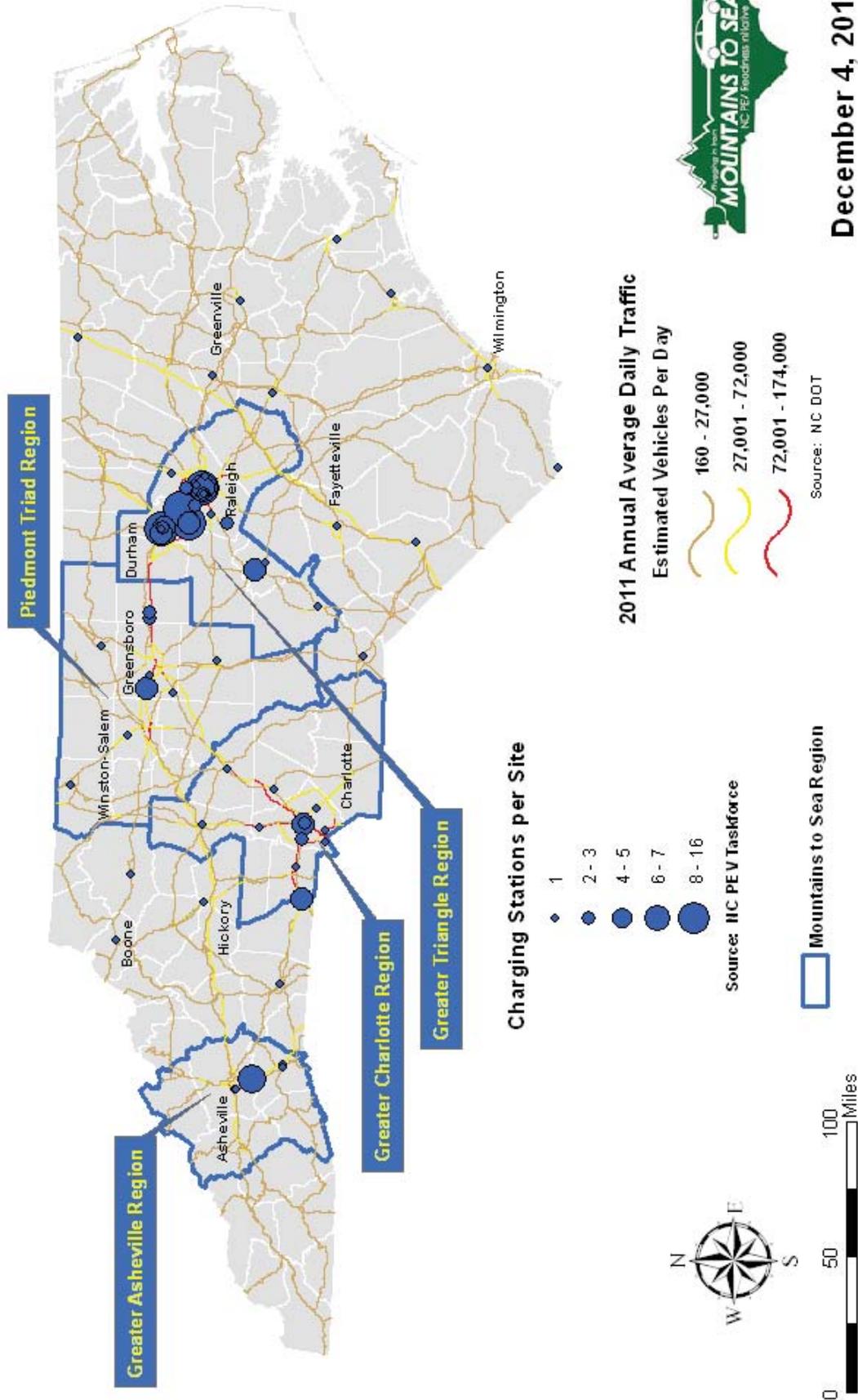


December 4, 2012

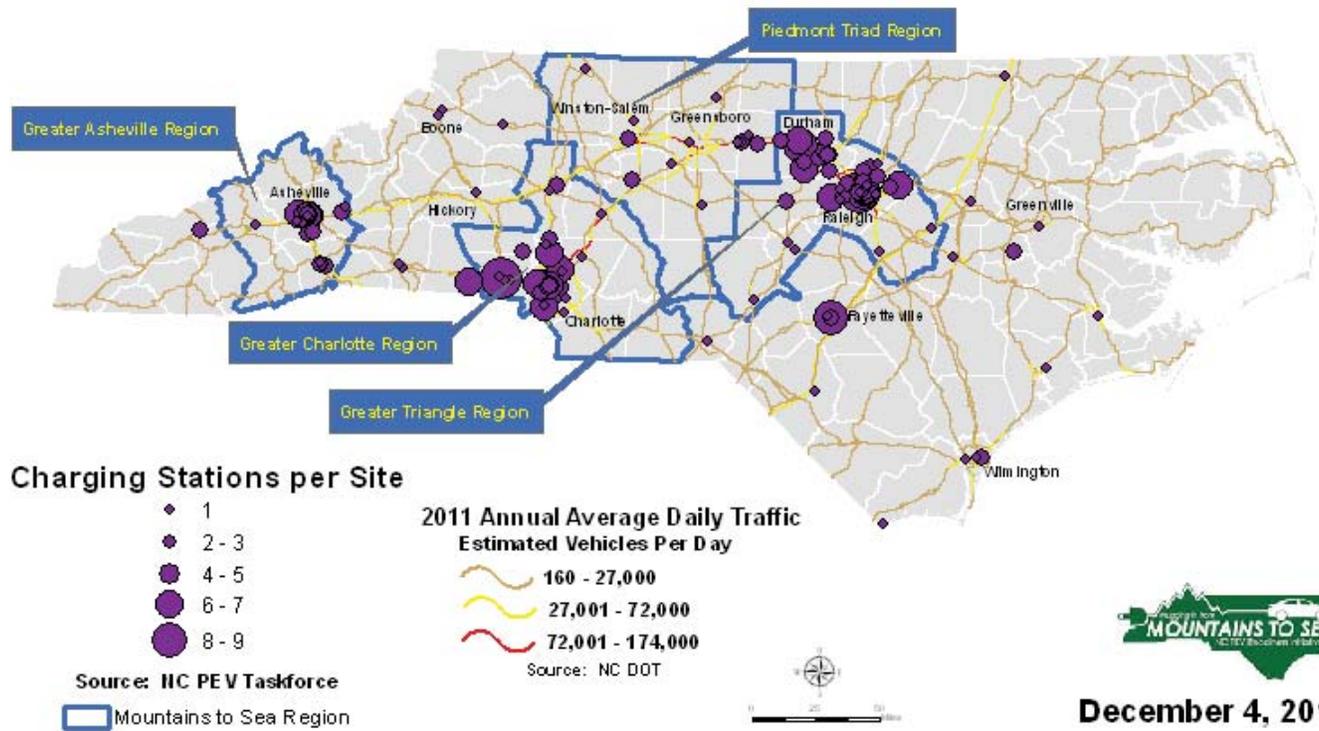
All Charging Sites in North Carolina August 2012



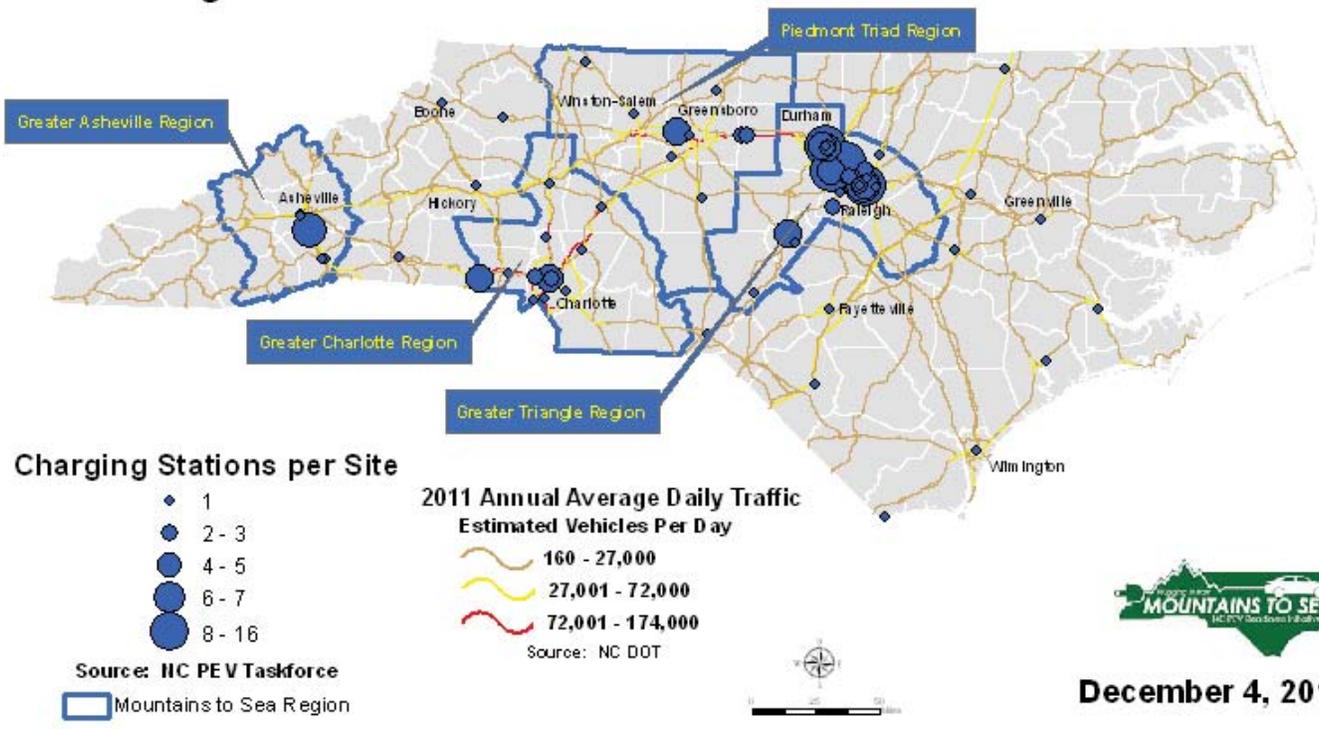
Private Charging Sites in North Carolina August 2012



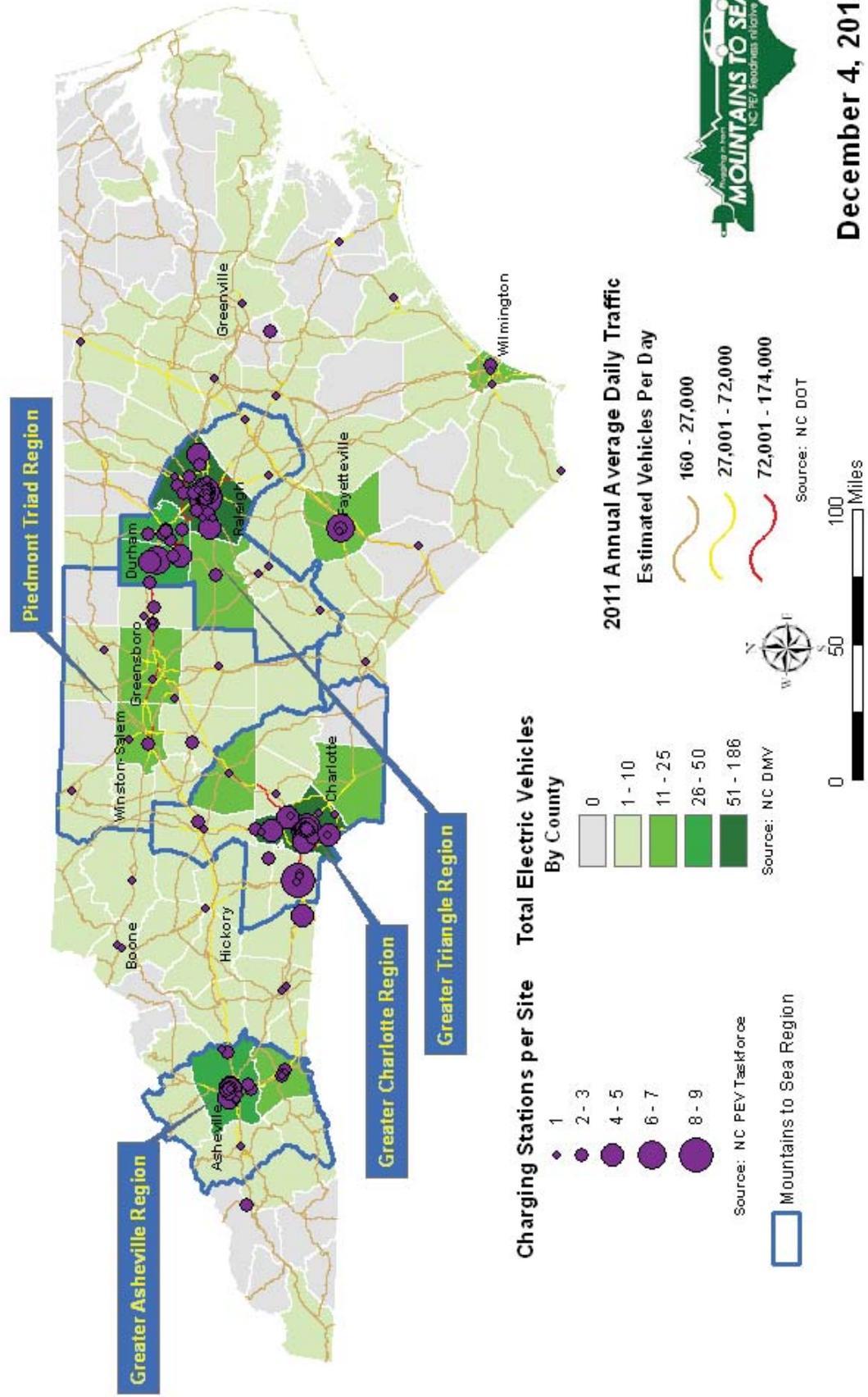
Public Charging Sites in North Carolina by County August 2012



Private Charging Sites in North Carolina by County August 2012

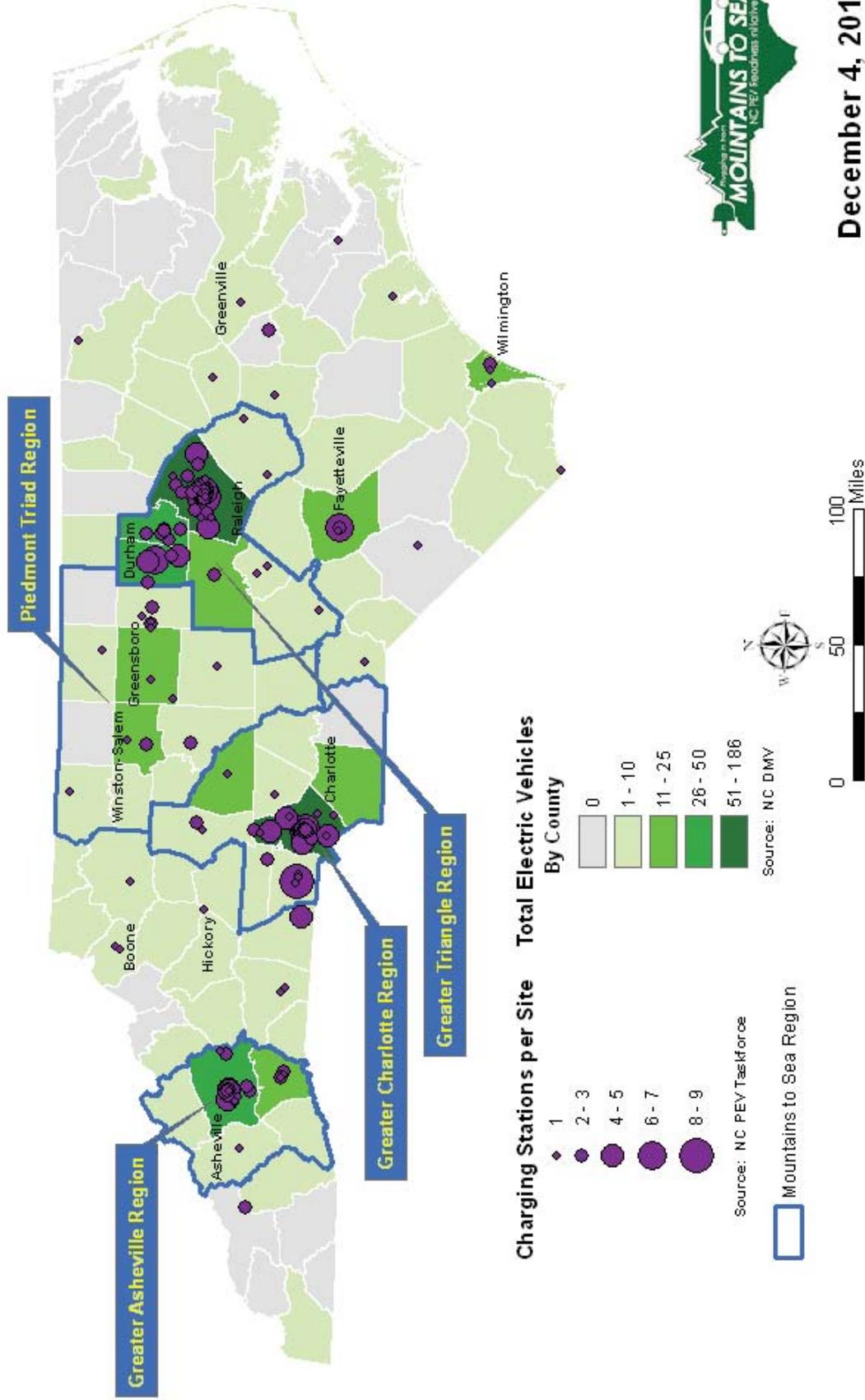


Registered Plug-in Electric Vehicles and Public Charging Sites in North Carolina August 2012



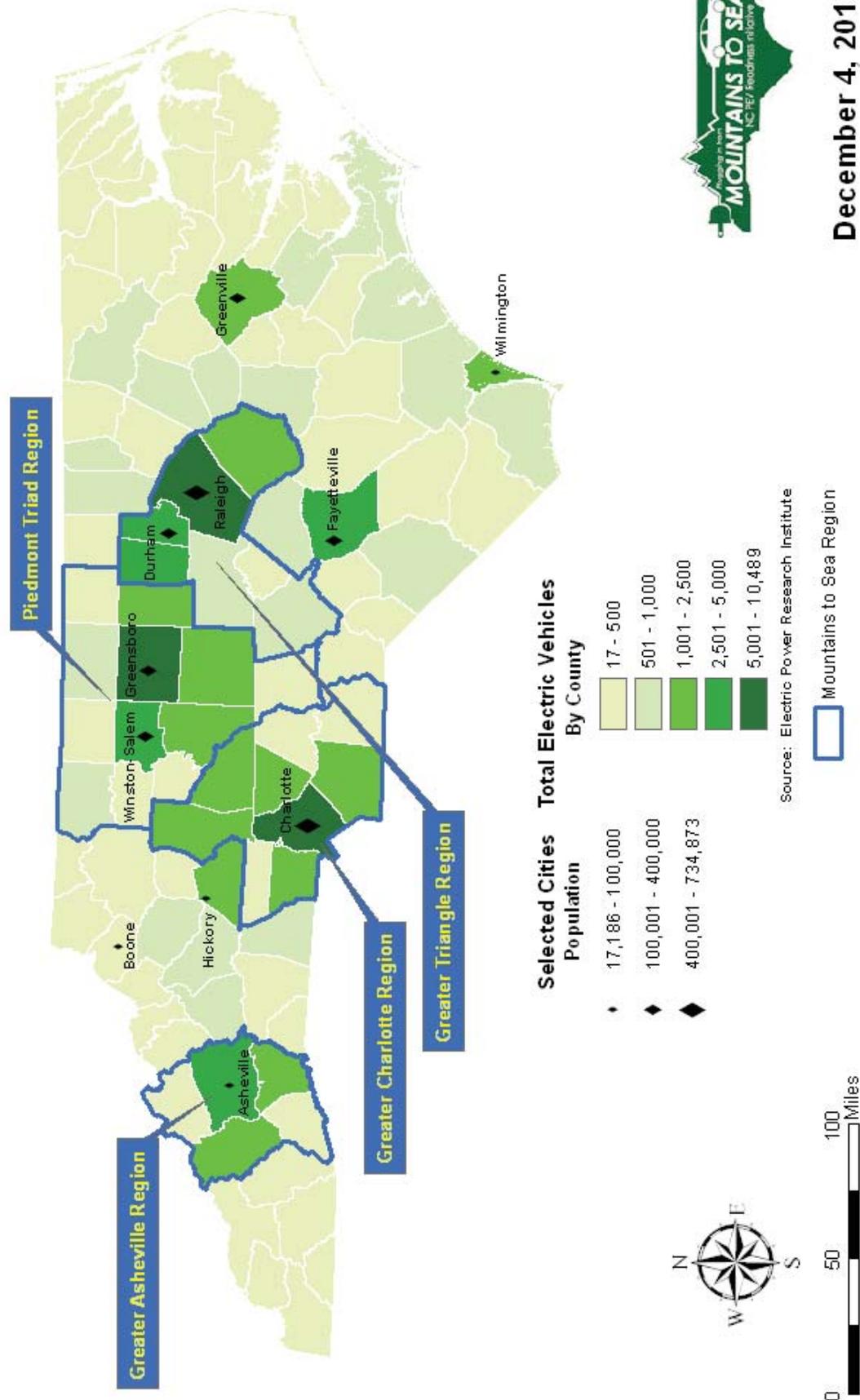
December 4, 2012

Registered Plug-in Electric Vehicles and Public Charging Sites in North Carolina August 2012



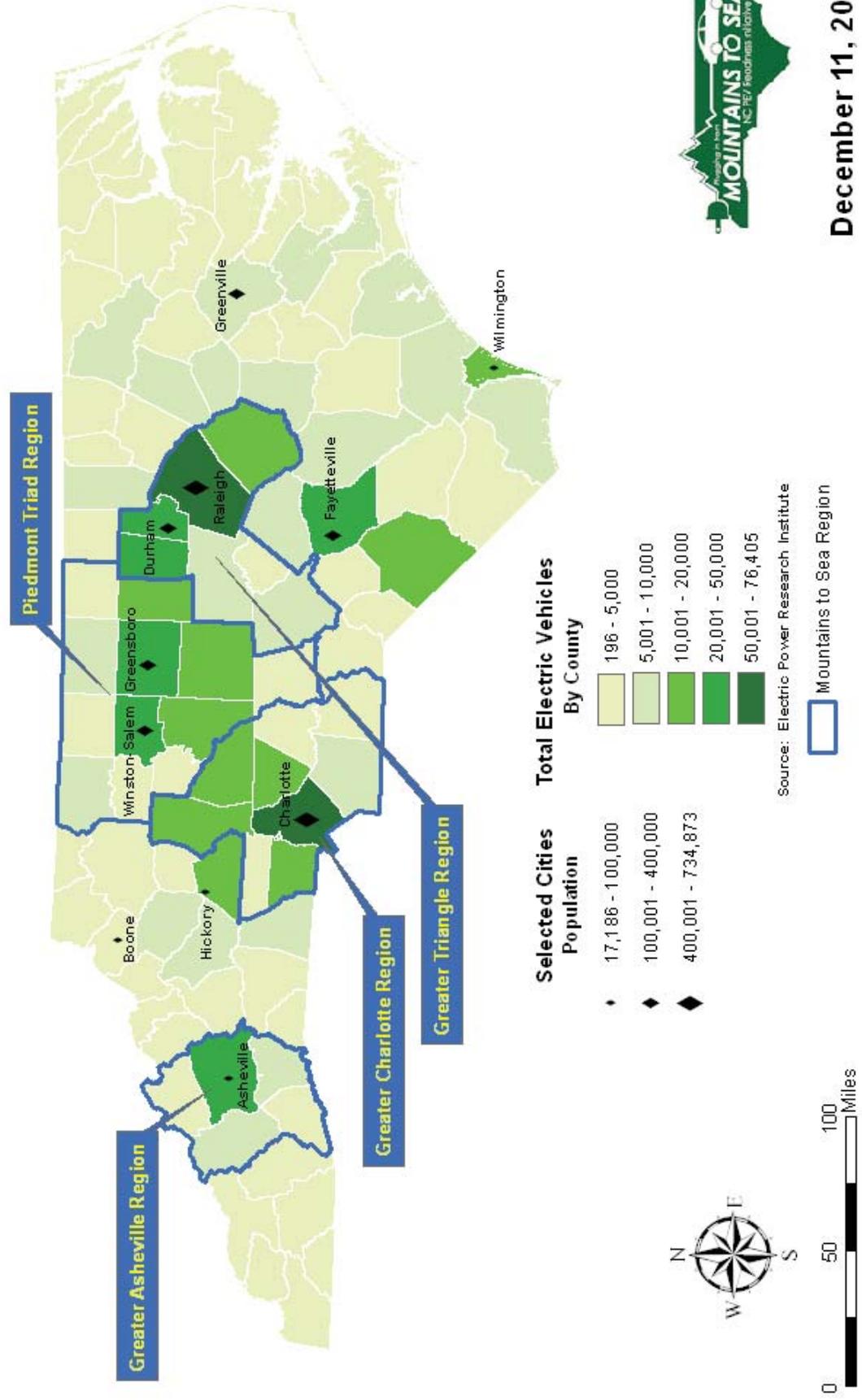
December 4, 2012

Projected Number of Registered Plug-in Electric Vehicles in North Carolina by County 2020



December 4, 2012

Projected Number of Registered Electric Vehicles in North Carolina by County 2030



December 11, 2012

APPENDIX 7

RIDE AND DRIVE KIT

Drive the Change



Tips for Scheduling PEV Ride and Drive Events

Ride and Drive events are great ways to introduce consumers to plug-in electric vehicles (PEVs). Not only can Ride and Drive events help create awareness of PEVs but the hands-on driver experience can help promote understanding and help ease driver anxiety.

Through the North Carolina Mountains To Sea initiative, in conjunction with the North Carolina PEV Taskforce, we encourage your communities to hold these events frequently! Included in your Drivers Kit:

- Sample Waiver and Liability Form
- Dealer Contact List
- Event Checklist

Drive the Change: Promote PEVs in your area today!



Ride and Drive Event Best Practices:

- Contact Local Dealers
- Choose Your Location
- Consider Legal Aspects
- Select a Route
- Market Your Event
- Ensure Enough Time for Proper Set Up



Drive the Change: Ride and DriveCheck List

□ SELECT DEALERS

Contact Your Local Dealers

- Contact local car dealerships who sell PEVs and invite them to participate in your ride-n-drive event.
- Having a large event? It is better to have a large number of dealers on site to maximize the number of rides you can offer
- Having a small event? You may want to stick to a small number of dealers who will have the opportunity to offer rides to a reasonable number of participants.

Remember, you don't want a dealer to show up to an event with 10 people and 4 other dealers offering a ride in the same type of vehicle. Make it worth their time!

Encourage Dealer Participation

- Tell them about your target audience
- Tell them how many people you are planning for
- Offer them recognition as a participating dealer
- Recognition can be as simple as their name and logo on your event website and a link to their website
- Remember, car dealers are in the business of selling cars, so you want to make the event worth their time. Time is money! Pitch an opportunity where they can market themselves while helping you promote PEVs.

Confirm Dealer Contacts

- Determine your contact person for coordination of the event and also request contact information for the salesperson who will actually attend the event

What is Needed?

- Ask participating dealers about liability coverage for test drives.
- Do participants need to sign a waiver of liability form prior to test driving a vehicle?
 - Usually dealers only need to see a photo identification of a driver prior to participating in a ride-n-drive event. But, check with each dealer to be aware of individual liability policies.
- Ask dealers about their vehicle charging needs

Remember that they need enough charge to get to the event, test drive the vehicle with participants, and get back to their dealership

□ CHOOSE LOCATION

Identify Charging Infrastructure

When looking for a location, prioritize finding a location where charging infrastructure is available at the site or reasonably nearby.

- If there is no charging infrastructure, but a standard electrical outlet is available or possible, work with the facility manager to determine the best set up for charging that will avoid tripping hazards.
- If Level 2 charging or greater is available at a site, reserve the parking spaces for vehicles based on the distance each participating dealer is driving.
- Make charging availability a priority for dealers driving a further distance to participate in your event. This way you can maximize the number of rides during your event.

Preferred Sites

A preferred site is at a location where:

- Vehicular traffic can be controlled or where there is low vehicular traffic
- Parking arrangements include parking spaces located in a highly visible area where foot traffic can be controlled
- Consider a parking space that will allow the driver to backup, this way they can experience the backup camera available in most PEVs

Work with Facility Managers

Work with a facility manager or event coordinator at your selected site to determine the best setup for your event.

- Ensure you have access to a facility contact on the day of your event that can assist you in making any last minute changes.
- Ask the facility manager or event coordinator about the flow of vehicular traffic and foot traffic
- Work with the facility manager or event coordinator to determine the flow of the event for a successful ride-n-drive
 - Will there be directional signs or staff persons the day of the event to direct the flow of traffic?
 - Will areas need to be blocked off?
 - Does someone need to move barriers to allow vehicles to enter and depart?

Drive the Change: Ride and Drive Check List

□ CONSIDER LEGAL ASPECTS

Contact Your Local Dealers

- Speak with the facility manager or event coordinator about liability issues
- Have a template waiver of liability form available to offer to the facility
- Clear yourself of any liability
- Speak with your legal department about waiver of liability or simply plug your name/company name into a waiver of liability form to make sure you are not held liable for any vehicular mishaps during the event
- Link to draft waiver of liability form

□ SELECT A ROUTE

Route Design

- Try to design a route with all right turns or as many as possible
- Circular routes are preferred
- Use a PEV to test the route
- Ask dealers to drive the route prior to the event to insure that they know the route and can instruct participants on where to drive, and to insure that the route is appropriate for their standards

Route Length

- Routes should be anywhere from 3/4- to- 1 mile
- Select a route where the driver can experience the PEV
 - A quarter mile stretch where the driver can go from 35-45 mph should suffice

Route Characteristics

- Look for a route with that has:
 - Diverse terrain, such as hills, curves, etc.
 - Low vehicular traffic

Once your route is selected, type it up in large, bold font and make copies to be placed on vehicle dashboards. Be sure to make an additional copy of the route for the registration table.

□ MARKET YOUR EVENT: SPREAD THE WORD!

Determine Target Audience

Once you know your target audience, think of creative ways to get their attention. You can determine your target audience by:

- Age
- Residential areas
- Workplace areas
- Economic status

Social Media

Can you reach your target audience through social media channels? Great social media outlets include:

- Twitter – tweet and ask others to re-tweet the event
- Facebook – make an event on Facebook
- Newsletters – include your event in newsletters that reach your target audience
- Bloggers - Contact your local blogs and pitch a story idea to them! They love new, fun and innovative stories!
- Blog – Blog about your event. Talk it up!

Develop Evites

Once you develop an evite, you can send it out through email list serves.

Request RSVPS

You may want to request an RSVP to attend (not for a time slot). This way you can plan accordingly for your turnout.

- Reserved time slots for participants work well for small events, not large events

Traditional Media

Is this a public event? If so:

- Distribute a press release
- Contact your local media outlets
- Invite the media for a special ride-n-drive time
 - Before you open your event to the public or your participants, set aside an hour prior to your scheduled event where the media can bring cameras, etc. and participate in your ride-n-drive event. This is a great opportunity for positive media coverage and makes for a fun story!

Drive the Change: Check List, cont.

□ SET UP YOUR EVENT

General To-Dos

- Have cones on hand! They will be helpful in saving spaces and directing the flow of foot traffic and vehicular traffic

Registration Table

Be sure to set up a registration table to include the following items:

- Sign in sheet
- Liability waiver form
- Wristbands or a marker
- After participants have signed in and registered, give them a wristband or mark their hand to allow access to the vehicles. This will help the dealers determine who is eligible to participate in the ride n drive events

Literature on Registration Table

- Extra copies of the route
- Provide additional information on PEVs, such as:
 - DOE Consumer Guide (link)
 - FAQs
 - Utility information
 - Vehicle information collateral (ask the dealers if they have collateral or SWAG that they can provide to you for your registration table)
 - Public Charging Station locations

If you are going a pre-drive media ride-n-drive, do not begin registration for the general public until the media is finished. This will help limit confusion.

Bring your camera, take picture, and have fun!

Drive the Change: Evite Example

The Drive-Thru Event You Don't Want to Miss!

Wednesday, October 19

PEV 101 Forum*

(registration required)
12 - 12:45 pm
Raleigh City Council
Chambers

Ride-n-Drive Event

(open to the public)
12:45 – 2 pm
Nash Square

Join Sustainable Raleigh and Advanced Energy for lunch and learn about plug in electric vehicles (PEVs)! If you are considering purchasing a PEV, then this is an event you won't want to miss!

This forum will address questions such as:

- What is a PEV?
- What types of vehicles are available in the market?
- How long will it take to charge a vehicle?
- What are some of the incentives available to purchase a PEV?



*Lunch will be provided for forum attendees.



Drive the Change: Template: Press Release

For Immediate Release

Join the Transportation Revolution: Test Drive a Plug-in Electric Vehicle at <name>'s Ride and Drive Event!

(City, State — Date) <Organization name>, in partnership with <dealership name>, will be hosting a Plug-in Electric Vehicle (PEV) Ride and Drive event on <date, time, location>. This event is open to the public.

<Provide information on:

Vehicles and types

Route

What drivers should bring to test drive, etc.>

For more information visit <web site URL>

Drive the Change: Resources: Local PEV Dealers

Car Dealership	Contact Person	Phone	Email

Drive the Change: Liability Waiver Example

DRIVER ACKNOWLEDGEMENT OF RISK AND WAIVER OF LIABILITY

In consideration of being permitted to drive a plug-in electric vehicle on _____ at _____, located at _____ as a part of a Ride-N-Drive event, I do hereby release, waive and discharge the _____ their representatives, its officers, employees, agents, advisors, employees, and members, from any and all actions, damages, claims or demands which I, my heirs, personal representatives, executors, administrators or assigns may have against any and all of the aforementioned for any and all personal injuries, accidents or illnesses (including death), known or unknown, which I have or may incur by participation in the above stated event and for all damages and loss to my property.

I understand that my driving for travel for participation in this event is voluntary and that this event carries with it certain dangers and risks, including but not limited to: overexertion, poor judgment, emotional strain, slipping, falling, tripping, equipment failure, vehicle failure, injury, death, etc. which could ultimately result in injury, permanent disability, or death. I further assume all responsibility related to complying with all applicable motor vehicle laws, including but not limited to: those concerning vehicle safety, vehicle operation, insurance, and the transportation and consumption of alcohol beverages, etc.

I realize that I am responsible for any injuries to persons or property which may be incurred in connection with driving for participation in this event. I also agree to indemnify and hold harmless the _____, their representatives, its officers, employees, agents, advisors, employees, and members from any and all costs, damages, liabilities and losses that they may incur due to my driving for travel and participation in this event.

I hereby agree to abide by any policies, rules and regulations adopted by the aforementioned. I further expressly agree that the foregoing acknowledgement of risk and waiver of liability is intended to be as broad and inclusive as is permitted by the law of the State of _____ and that if any portion is held invalid, it is agreed that the balance shall, notwithstanding, continue in full legal force and effect.

I, the undersigned, am at least 18 years of age. I have read this Driver Acknowledgement of Risk and Waiver of Liability and fully understand its terms. I acknowledge that I am signing this waiver freely and voluntarily with full knowledge of its significance.

Participant must be age 18 or older.

Printed Name

Driver's License State / Number

Signature

Date



Additional Resources

- *How to Drive Electric and Other FAQs on Electric Vehicles*
www.advancedenergy.org/transportation/resources/Etran_FAQs.pdf
- *Residential Charging Station Installation Handbook for Single- and Multi-Family Homeowners and Renters*
www.advancedenergy.org/transportation/resources/MUD%20Handbook%20FINAL%20Web.pdf
- *Charging Station Installation Handbook, Advanced Energy*
www.advancedenergy.org/transportation/evse/charging_station_installation_handbook.php

APPENDIX 8

REFERENCES/RESOURCES

REFERENCES / RESOURCES

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- 2 “Clean Cities Plug-In Electric Vehicle Handbook for Electrical Contractors”, U.S. DOE
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- 9 Brian Taylor, Land-of-Sky Regional Council, email, November, 2012
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- 26 <http://www.toyota.com/prius-plug-in/>
- 27 <http://www.insideline.com/ford/c-max/2013/2013-ford-c-max-energi-rollout-plans-detailed.html>
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64 NC GreenPower Website, <http://www.ncgreenpower.org/about/>

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APPENDIX 9

NC PEV INCENTIVE PAPER

PLUG IN ELECTRIC VEHICLE (PEV) INCENTIVES ANALYSIS AND OPTIONS FOR NORTH CAROLINA

November 2012

Aranzazu Lascurain
Anne Tazewell
NC Solar Center/NC State
University



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EXECUTIVE SUMMARY:

By providing environmental, energy and economic development enhancements, plug-in electric vehicles (PEVs) offer many benefits over internal combustion engines to North Carolina and the United States. Incentives often play an important role in the deployment of new technology that offers advantage over those that are more established. A series of NC PEV Task Force Incentives and Economic Development Working Group meetings were conducted in 2012 as part of the NC PEV Readiness Initiative, *Plugging In from Mountains to the Sea*, planning project. A survey of North Carolina fleet managers and others associated with the purchase of vehicles, a PEV Incentives Prioritization Table, and PEV incentive case studies of five states neighboring or nearby to North Carolina were also developed to determine a set of PEV incentive policy recommendations for North Carolina. Recommendations include: continued support for programs that already support or could support more widespread adoption of PEVs by the state fleet and individual consumers, elimination of 3% state highway use tax for purchase of PEVs, a vehicle rebate, and an electric vehicle service equipment tax credit. A NC PEV Implementation Council is recommended to facilitate and coordinate more widespread PEV adoption.

HIGHLIGHTS:

- As of August 2012 there were 719 PEVs in use in North Carolina and as of September there are 228 electric vehicle supply equipment (EVSEs) sites at public and private locations not including home recharging units.
- There is a significant presence of PEV related industries in North Carolina. Currently, there are 63 companies involved in the manufacturing or distribution of PEVs and North Carolina is ranked number 10 in the country for employing the highest number of auto related workers in the clean efficient technology sector.
- Benefits of PEVs include: zero tailpipe emissions, reduced operating costs and increased performance over vehicles with internal combustion engines (ICEs).
- The most significant barrier to more widespread adoption to PEVs is the cost. A combination of both state and federal incentives greatly reduces the payback period for the incremental cost difference between a PEV and an ICE vehicle.
- A federal tax credit of up to \$7,500 per vehicle is available to off-set the cost of a PEV.
- Incentives that offer up front cost reductions for the purchase of a PEV, such as eliminating vehicle sales tax, are most attractive to a consumer and may cost states less in lost revenue per vehicle than vehicle tax credits.
- North Carolina has a number of grant programs that have supported or could support PEV adoption and related business development although many are inactive or set to expire. Other than grant assistance to public and private fleets, North Carolina does not offer any financial incentives to support PEV deployment while neighboring states, Georgia, South Carolina, Tennessee and Maryland, all offer tax credit or rebates for vehicles and/or charging infrastructure.
- Based on 2010 Census data for North Carolina neighboring and nearby states in which numbers of PEVs registrations are available, the states with greater penetration of PEVs are those with greater financial incentives. Tennessee, with the greatest incentives of the survey group, has a .0211% penetration of PEVs

when correlating percentage penetration of PEVs in 2012 as compared to automobiles (including taxis) registered in 2009, whereas North Carolina has a .0208% penetration rate.

- In a competitive economic climate, businesses are looking to locate in states that support their product. Incentives to spur PEV use also helps foster in-state economic development. Nissan is expected to add 1,300 jobs at its Smyrna, Tennessee plant to support manufacturing of the all-electric Leaf¹. In Maryland, General Motors already has an electric transmission facility and will build the 2013 Spark PEV in White Marsh, MD. Both Tennessee and Maryland offer a wide array of incentives to spur the adoption of PEVs.



INTRODUCTION:

Widespread consumer adoption is crucial to the success of electric cars. Plug-In Electric Vehicles (PEVs) now provide an uncommon opportunity for the U.S. to move toward reduced overall vehicle emissions, greater national energy security, and economic growth. Wide-spread market adoption of electric vehicles requires financial policies to help deploy them. New technologies, such as PEVs, are more expensive in their market infancy. Financial incentives help make them more alluring for public and private investment by lowering inhibitive upfront costs and in turn, facilitating their penetration into the U.S vehicle market. Without sustainable commercial success of PEVs, automobile manufacturers will have little motivation to continue producing electric vehicles, let alone develop second generation designs and more advanced batteries. For this reason, it is imperative to offer U.S. vehicle consumers a suite of incentives that make PEVs competitive with internal combustion engine (ICE) vehicles. This paper explores incentive options that could facilitate a successful launch of PEV use in the state of North Carolina.

STATE OF MARKET POSITION OF PEVs:

As of August 2012 there were 719 PEVs in use in North Carolina.² When correlating percentage penetration of PEVs in 2012 as compared to North Carolina automobiles (including taxis) registered in 2009, a .0208% penetration rate has

¹ Danny King, "Nissan Tennessee Doubles Workers for Leaf, Battery-Pack Ramp Up". Accessed September 5, 2012. <http://green.autoblog.com/2012/03/09/nissan-will-double-tennessee-workers-for-leaf-battery-pack-ramp/>

² Brennan Bouma, Triangle J Council of Governments, NC DMV data, email to author, September 21, 2012.

been achieved to date. Whereas North Carolina has over 6,800 gasoline stations³ as of September, 2012 there were 228 electric vehicle supply equipment (EVSEs) units (public and private locations not including home recharging units).⁴ With 63 PEV related companies consisting of manufacturers, suppliers and distributors of electric vehicle equipment and components⁵, North Carolina is poised to benefit from increasing PEV adoption. Economic development opportunities abound for North Carolina because the PEV sector connects many distinct industries such as automakers, electricity providers, charging equipment and battery manufacturers, distributors of the technology and, of course, consumers. We can expect this sector to continue to expand, not only in tandem with the smart grid industry (North Carolina is home to a leading global smart grid cluster) but with other renewable energy industries.⁶

BENEFITS OF PEVs:



By supporting fuel diversity and reducing tail pipe emissions, the benefits of PEVs include economic and environmental enhancement for North Carolina and the nation as a whole. In 2011 the U.S. transportation sector was 93% reliant on petroleum with transportation usage accounting for 71% of all the oil used in the United States.⁷ Moreover, the U.S. is heavily dependent on imported petroleum, with 55% coming from other countries⁸. With no petroleum production and refining capability, North Carolina imports virtually all of the petroleum used for transportation from other states and countries.

It is also important to note the negative impacts on the environment and human health that stem from internal combustion engine (ICE) emissions utilizing gasoline and diesel. According to the American Lung Association 2011 State of the Air Report, North Carolina has over 3,042,647 residents with health problems such as asthma or emphysema, and poor air quality is a contributing factor. Currently North Carolina has 24 counties that have been designated with a non-attainment or maintenance status for national ambient air quality standards. In the state's urban areas, tail pipe emissions are the primary source of air quality problems.

With automobiles accounting for 32% of U.S. petroleum use⁹ expansion of feasible options for passenger vehicles is an important step towards a clean transportation future. Electric vehicles are well suited to provide a viable alternative to the ICE. Electric motors are much more efficient than gasoline engines. Whereas electric vehicles use up to 62% of the energy received from charging, with ICEs only 17-21% of the energy in gasoline is utilized to operate the vehicle.¹⁰ Gasoline engines can lose up to 33% of the fuel energy in their exhaust emissions alone while electric vehicles have no tail pipe emissions at all. PEVs offer exceptional performance as well. PEVs have tremendous torque and can accelerate faster than ICE vehicles. Plus, they offer a quiet and safe ride.

³ U.S. Energy Information Administration, North Carolina Energy, Updated October 18, 2012.

Factsheet:<http://www.eia.gov/beta/state/data.cfm?sid=NC#DistributionMarketing>

⁴ Brian Taylor, Land of Sky Council of Governments, email to author, October 10, 2012.

⁵ See Appendix for NC PEV Industry List compiled by NC Solar Center and NC Dept. of Commerce, 2012

⁶ NC Sustainable Energy Association, North Carolina Renewable Energy and Energy Efficiency Industries Census, 2011.

⁷ EIA Energy Explained Table 1. Accessed August 14, 2012. <http://www.eia.gov/energyexplained/#tab1>

⁸ EIA, Energy in Brief. Accessed August 14, 2012. http://www.eia.gov/energy_in_brief/foreign_oil_dependence.cfm

⁹ The Future of Energy, Analyzing the Options, "Energy Use by Vehicle Type". Accessed August 21, 2012.

<http://energyfuture.wikidot.com/us-energy-use>

¹⁰ U.S. Dept. of Energy. Accessed August 21, 2012. <http://www.fueleconomy.gov/feg/evtech.shtml#end-notes>

While the initial costs for PEVs are higher, there can be significant long term savings in ownership. In North Carolina filling up a gasoline tank can cost anywhere from \$3.00-\$4.00 a gallon in 2012, however electric vehicle charging costs about \$.75-\$1.00¹¹ to go the equivalent number of miles as a gasoline vehicle that averages 25 miles per gallon. Moreover, there is less regular maintenance required for electric vehicles, and no need for continued oil changes.

As PEV technology continues to advance and more manufacturers are offering all electric or plug in hybrid electric models, PEVs have become an attractive alternative for cars with gasoline engines. Because of the importance of PEVs to our economy and the environment, federal and state governments are offering incentives to consumers who make the switch to PEVs. For those who qualify, the federal government offers up to a \$7,500 tax credit to the first owner of an electric car.¹² With the current \$7,500 tax credit, the total cost of ownership of a PEV with a 100 mile range is less than the average annual price of the PEV at current gasoline prices with 120,000 lifetime miles¹³. However at this time, many consumers are unable to overcome the initial increase in price to realize the over-all benefits.

THE ROLE OF INCENTIVES:

New technologies, such as PEVs, are more expensive in their market infancy. Financial incentives help address the primary obstacle of PEV adoption: **COST**. Incentives make PEVs more alluring for public and private investment by lowering inhibitive upfront costs and in turn, facilitating their penetration into the U.S vehicle market until reaching economies of scale. Incentives, in effect, help consumers purchase PEVs while automakers work at bringing costs down (volume and increased efficiencies in battery technology).¹⁴ Most state and federal incentives at the present time have limited durations either by fixed dates or maximum funding caps.¹⁵

Incentives for electric vehicles and infrastructure are warranted because they help move the U.S. away from older more polluting technologies and closer towards technologies that not only save the consumer money in fuel costs (avoiding oil price volatility), but support a national move towards greater energy independence. Incentives mean putting new funding and policies in place to spur the growth of new technologies while rewarding the consumer. Additionally, electric vehicle technology can be an important driver for economic growth. Recent investments in the automobile sector to increase supply of fuel-efficient and advanced technology vehicles, is a testament to the projected job growth rates in this sector.¹⁶ North Carolina, for example ranks number 10 in the U.S. for states employing the highest number of autoworkers in clean, efficient technologies.¹⁷ Adoption rates for electric vehicles are almost twice as high then those of hybrids at the same stage of their launch.¹⁸ These rates will continue to be variable depending on gas prices, manufacturer availability, availability of additional PEV models, continuation of federal and state tax incentives, and level of public outreach and consumer education.

¹¹ U.S. Dept. of Energy, "Comparing Energy Costs per Mile for Electric and Gasoline-Fueled Vehicles" (assuming \$.11 per kWh rate, EV 3 mi/kWh and avg. 25 MPG). Accessed October 5, 2012. <http://avt.inl.gov/pdf/fsev/costs.pdf>.

¹² The federal tax credit for PEVs lasts until a manufacturer sells 200,000 vehicles. The credit then goes into a one year phase-out. Refer to the IRS tax code for electric vehicles for more information about phase out year: [http://www.irs.gov/Businesses/Plug-In-Electric-Vehicle-Credit-\(IRC-30-and-IRC-30D\)](http://www.irs.gov/Businesses/Plug-In-Electric-Vehicle-Credit-(IRC-30-and-IRC-30D))

¹³ Lisa Jerran, John Gartner," Executive Summary: *Total Cost of Ownership of Alternative Fuel Vehicles for Fleet Operators*" Pike Research, Q2 2012.

¹⁴ Britta Gross, "GM's PEV Directional Policy Recommendations", General Motors, 2012.

¹⁵ U.S. Department of Energy/AFDC. Accessed August 23, 2012.

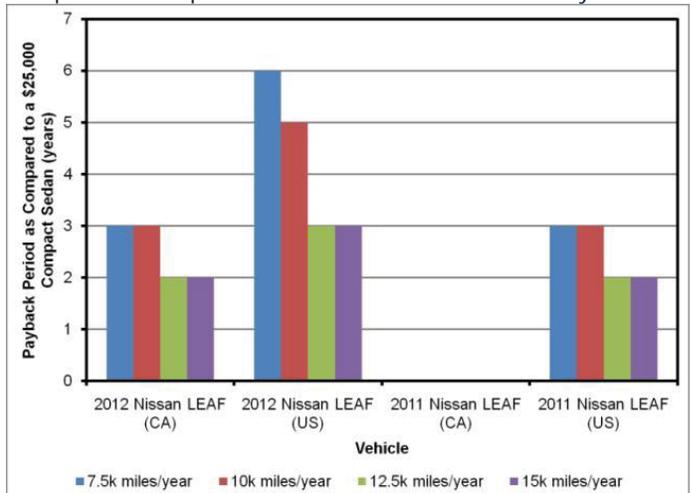
¹⁶ Ceres, "Higher MPG = More Jobs and a Stronger Economy for North Carolina". Accessed August 24, 2012. www.ceres.org/files/report-fact-sheets/more-jobs-fact-sheets/north-carolina; Tiffany Ingram, "Driving Growth" Accessed August, 2012, www.drivinggrowth.org/auto-jobs-are-growing-and-fuel-efficiency-is-a-major-factor/.

¹⁷ Natural Resources Defense Council, "Supplying Ingenuity, U.S. Suppliers of Clean, Efficient Technologies", August 2011.

¹⁸ U.S. Department of Energy; EPRI, December 2011. Product ID #1021848

In summary, one of the single most important barriers to PEV adoption is the up-front cost of PEVs and the relatively low cost of gasoline (compared to most developed countries). A combination of both state and federal Incentives greatly reduces the payback period for the incremental cost difference between a PEV and ICE vehicle. The following graph from the Electric Power Research Institute illustrates how the payback period of the Nissan LEAF is cut dramatically with both a federal and state tax incentive in the state of California as compared to the U.S.¹⁹

Figure 1: Payback Period as Compared to a \$25,000 Compact Sedan (years). Source: EPRI 2011



TYPES OF INCENTIVES:

If the hybrid electric vehicle (HEV) adoption trajectory is taken into consideration as an analogous model for PEV adoption, the recent past indicates that state and federal tax incentives were very important and successful in meeting their intended goal: to spur the adoption of this vehicle technology.²⁰

Research on the efficacy of incentives to drive electric vehicle adoption reveals that the type of tax incentive is as important as the value of the tax incentive. A Kennedy School of Government white paper found that sales tax exemptions created greater consumer response because it is immediate and transacted at the point of sale.²¹ In spite of its tax value being **less** than an income tax credit value, a sales tax exemption creates greater demand for the vehicle because it is immediate and quick.²² Typically, a tax credit requires consumer time to understand, apply for, and wait until tax filing time to recoup the financial savings.

The following provides a brief overview of financial and non-financial incentives for hybrids and/or plug in electric vehicles, as well as other alternative fuel vehicles.

Financial

- **Grants:** Financial assistance programs from a federal or state agency to a recipient to carry out a public purpose of support or stimulation authorized by a law of the United States or an individual state.²³ The American Recovery and Reinvestment Act (ARRA) of 2009 provided stimulus funds in the form of grants to government and private entities to defray costs for alternative fuel and electric vehicles (among many other funded project areas). Grants have served as a critical incentive for the deployment of new technologies. North Carolina

¹⁹ Figure 1 courtesy, Mark Duvall, Director of Electric Transportation at EPRI, 2011.

²⁰ Kelly Gallagher and Erich Muehlegger, *Giving Green to Get Green: Incentives and Consumer Adoption of Hybrid Vehicle Technology*, Kennedy School of Government Working Paper, February 2008.

²¹ Kelly Gallagher and Erich Muehlegger, *Giving Green to Get Green: Incentives and Consumer Adoption of Hybrid Vehicle Technology*, Kennedy School of Government Working Paper, February 2008.

²² David Diamond, "The Impact of Government Incentives for Hybrid Electric Vehicles: Evidence from U.S. States", *Energy Policy* 37 (2009); 972-983, accessed on August 2, 2012, http://www.uns.ethz.ch/edu/teach/bachelor/energymob/Diamond_2009.pdf.

²³ See: <http://www.grants.gov/>

received over \$12 million dollars from ARRA through Triangle J Council of Governments/Triangle Clean Cities for the deployment of alternative fuel and advanced technology vehicles and infrastructure in North and South Carolina. The Carolina Blue Skies and Green Jobs Initiative specifically helped fund 48 electric vehicle charging stations in North Carolina. Another grant program which helps fund electric vehicle projects is the state's Clean Fuel Advanced Technology (CFAT) Program which utilizes federal Congestion Mitigation and Air Quality funds authorized through the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). CFAT has funded 35 PEVs and 6 EVSEs. For more information on CFAT see North Carolina Case Study below.

- **Income Tax Credit:** A sum deducted from the total amount a taxpayer owes to the federal government (or state) and used as an incentive to encourage investment or consumer behavior in a particular sector. The most important tax incentive for PEVs is the federal \$7,500 tax cred currently in place. Many states also offer tax incentives for PEVs. Using both the federal and a state tax incentive could make a PEV comparable in cost to a conventional vehicle. See *State Case Studies* below.²⁴
- **Mail-In Rebate:** See *Tennessee Case Study* below. Several states in the U.S. (Illinois, California, Tennessee, and New York) have passed bills to offer new electric vehicle purchasers additional funds to reduce the up-front cost of ownership.²⁵ Typically, this consists of a mail-in application with proof of purchase.
- **Sales/Use Tax Exemption:** PEVs receive exemption from paying their respective state's sale/use tax at the time of vehicle sale or title transfer sale. States such as Washington, Colorado, and New Jersey currently offer this incentive. The exemption, in the form of a sales tax or highway use tax, could represent several hundred to over a thousand dollar cost reduction for a consumer.
- **Licensing/Registration Credit/Exemption:** PEVs receive exemption from paying full or partial registration or licensing fees from their respective states.²⁶
- **Emissions/Motor Vehicle Exemptions:** PEVs are exempt from state emissions inspection requirements because there are no tailpipe emissions. Consumers save the expense of paying for the inspection fee. This fee in North Carolina is \$30. In N.C. qualified plug in electric vehicles are currently exempt from state emission inspections.
- **Public Parking Fee Exemption:** Most electric charging on public streets is free at this time. Additionally, some states, offer free public parking for PEVs (Hawaii, Nevada, and Arizona).

Non-financial

- **Try Before You Buy Program:** Enterprise Rental Company has launched the *Try Before You Buy Program*. Enterprise-Rent-A-Car allows prospective PEV consumers to rent a PEV for a day or up to a month. Chris Sbarbaro, vice president of sales and marketing for Enterprise in Hawaii, said that customers who rent EVs as replacement vehicles (while their current cars are being repaired) are more likely to purchase the same or similar make and model in the future. Sbarbaro said there has been a demand for EVs since Enterprise introduced the first fleet on O'ahu, and he expects the demand to increase--as more consumers become amped up about EVs. Enterprise is piloting extended test drive vouchers to local municipalities in California.
- **High Occupancy Vehicle (HOV) Lanes and Carpool Access:** Alternative fuel and electric vehicles may use HOV lanes regardless of the number of occupants in a vehicle. Access to HOV lane use has been an early and widely used incentive in the U.S. especially in high traffic urban areas. N.C. currently allows HOV access to single occupancy PEVs.

²⁴ See: <http://www.afdc.energy.gov/laws/>

²⁵ U.S. Department of Energy, AFDC

²⁶ Go to AFDC website and query by state under *Laws and Incentives*: <http://www.afdc.energy.gov/laws/>

- **State PEV Implementation Councils:** A board, council or commission could be established by the Governor via an Executive Order. North Carolina currently has over 400 such groups that oversee, advise and coordinate a variety of initiatives and activities ranging from the Acupuncture Licensing Board to the Wildlife Resources Commission²⁷. A PEV Implementation Council could also be voluntarily or legislatively created to coordinate and oversee PEV deployment activities. Maryland has the legislatively created Maryland Electric Vehicle Infrastructure Council.

Private Incentives

- **Car insurance discounts for alternative fuel vehicles:** Hartford Insurance announced in April 2012 that it would start offering a 5% discount to EV owners throughout the U.S. by the end of the year. The company described the offer as part of its commitment to encouraging environmental sustainability.
- **Work site charging:** Many companies are offering complimentary work site charging. Research Triangle Institute in North Carolina's Research Triangle Park is currently offering this incentive.
- **Employer clean vehicle incentive:** A current example of this incentive is Bank of America will reimburse employees \$3,000 who purchases a hybrid (gas/electric) vehicle. To qualify, the employee must live within 90 miles of Boston, Charlotte, or Los Angeles.
- **Utility Rebates:** At least three utility companies (The Los Angeles Department of Water and Power, Indiana Michigan Power, and Austin Energy) in the U.S. offer rebates for the purchase of PEVs and/or EVSEs. These typically come with a threshold limit and/or specific deadline to file.

NORTH CAROLINA FLEET INCENTIVES SURVEY & RESULTS:

The Incentives and Economic Development Working group of the N.C. Plug-In Electric Vehicle Task Force conducted a state-wide survey to gauge interest in plug-in electric vehicles among North Carolina fleet managers and persons responsible for and/or involved with vehicle purchase decisions. The survey was launched on March 7, 2012 and data was collected until April 18, 2012. The data collected, among other things, has helped the Working Group prioritize incentives perceived to be helpful in spurring the adoption of PEVs among public and private fleets in North Carolina as well as identifying barriers to the successful launch of PEVs in NC. (Refer to Appendix for complete survey questions and results)

Plug-In Vehicle Incentives Survey Highlights:

- The nine question survey was sent to 837 fleet related contacts across the state and achieved a 23% response rate with 187 completed surveys. Respondents were not required to answer every question, thus a higher response rate was achieved on specific questions.
- Over 50% of respondents drive 50 miles or less daily which easily fits into the range of PEVs.
- Almost 75% of vehicles return to common area which indicates that they can be charged overnight at fleet parking lots.

²⁷ North Carolina, "Boards and Commissions", Office of the Governor. Accessed October 5, 2012. <http://www.governor.state.nc.us/boardsCommissions/default.aspx>

- About 65% of respondents say they utilize vehicles in the range of 7-10 years. This helps with calculating the financial payback feasibility of purchasing EVs. Almost 34% say they keep vehicles 10 or more years which allow for PEV total cost of ownership savings to accrue.
- 83% of respondents (190 out of 229) stated that their organization would consider purchasing a PEV that initially cost more than a conventional vehicle if they could recoup 100% of the difference between the PEV and conventional vehicles. 69% stated they would purchase a PEV if 60% of the price difference was provided for.
- When asked what the most effective incentives are to encourage purchase/use of PEVs, 49% of respondents rated grants as "extremely effective" while 46% considered vehicle purchase price rebates as "extremely effective" out of a choice that included seven monetary and non-monetary incentives.

U.S. CASE STUDIES

North Carolina and five neighboring or nearby states are profiled below on their PEV related incentive offerings.

Georgia

The Georgia Department of Natural Resources, Environment Protection Division (EPD) administers two tax credits to incentivize the adoption of plug-in electric vehicles (PEVs). A \$5,000 tax credit is available to all full size electric vehicles registered in the state. The tax credit may not exceed an applicant's tax liability but may be carried over for up to five years. Plug in hybrid electric vehicles, such as the Chevy Volt, and low speed electric vehicles are not eligible for the credit. Georgia EPD or the dealer issues certificates for qualified vehicles which must then be sent in with the taxpayer's income tax return to receive the tax credit.

An EVSE tax credit of 10% of the cost, up to \$2,500 is available to business enterprises such as manufacturing, research, tourism and distribution. However, retail businesses are not eligible to claim the credit. The State of Georgia (GA) also offers a special license plate for alternative fuel vehicles (AFVs), such as PEVs, which allows access to HOV lanes. Vehicles with AFV plates are also eligible to apply for a Peach Pass for toll exempt access to Peach Pass controlled toll centers. AFV plate applicants pay an additional one-time Manufacturing Fee and Annual Special Tag fee.

Georgia Power offers a whole house time-of use (TOU) electricity rate for residential customers who own a PEV that provides a discount on electricity used between 11:00 PM and 7:00 AM. The rate is designed with the charging of plug-in vehicles as one of many loads in the home and does not require the installation of a separate meter. In addition, PEV planning has been supported through a 2011 U.S. Department of Energy (DOE) \$545,400 grant to GA's Center for Transportation and the Environment to spur adoption in a tri state area- GA, South Carolina and Alabama.

The number of PEVs registered in GA is not known to PEV planning professionals at this time. However, the GA EPD issued 80 certificates in 2011 for the PEV tax credit eligibility.

Maryland

Maryland (MD) has a suite of incentives and policies to support more widespread adoption of PEVs. These include: a PEV and electric vehicle supply equipment (EVSE) tax credit and the establishment of the Maryland Electric Vehicle Infrastructure Council (MEVIC). The MEVIC, created by statute in May 2011 and comprised of a variety of public and private stakeholders, is charged with developing an action plan for successful deployment of PEVs in MD by June 2013.

The Governor's office, which is home to the Maryland Energy Administration (MEA), spurred the MEIC initiative which is being led by the state Department of Transportation (MDOT). The MEIC is credited with two policies that are currently facilitating PEV planning and use: a PEV Information Discloser which allows for the MD Motor Vehicle Administration to provide addresses of registered PEV owners to electric utilities for planning purposes and an EVSE Regulation Exemption that exempts EVSE owners and operators from state regulation as electricity suppliers.

The MEIC will also be recommending an extension of the \$2,000 vehicle tax credit after it expires in July 2013. MD purchasers of qualified PEVs may now apply for a tax credit of up to \$2,000 against the imposed 6% excise tax. A total of \$2.5 M has been budgeted for the PEV tax credit. As of the end of June 2012, 439 PEVs titled in the state claimed \$858,506 of the funds available for the credit. MD residents apply to MD Division of Motor Vehicles for the tax credit through a short application which is forwarded to MEA for payment and tracking.

The EVSE tax credit is based on calendar years and is equal to the lesser of \$400 or the state income tax imposed for that tax year. A total of \$1.5 million has been set aside for a three year program with the following annual allocations: 2011-\$400,000, 2012- \$500,000, 2013- \$600,000. For 2011, 35 tax credits were awarded for total of \$7060.58. Based on experience with a bio-heating oil tax credit; credit requests typically come in around tax time, hence by April 2013 the State will know how much of the credit was utilized for calendar year 2012.

PEV adoption is supported through MDs participation in the Regional Greenhouse Gas Initiative (RGGI), the first market-based regulatory program in the United States to reduce greenhouse gas emissions. RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. Together, these states have capped and will reduce CO₂ emissions from the power sector 10 percent by 2018. Utilities purchase CO₂ allowances through auctions. Revenue from the auctions is distributed by formula and spent by states for a variety of programs including energy and low income bill payment programs. Legislation was passed that allocated RGGI funds to the specific PEV incentive programs in MD.

North Carolina

North Carolina has no state tax incentives for the purchase of an electric vehicle or installation of electric vehicle service equipment (EVSE). As per 2011 legislation, qualified plug-in electric vehicles may use North Carolina HOV lanes, regardless of the number of occupants.²⁸ However, HOV lanes are confined to I-77, 10 miles southbound and 5 miles northbound. Currently, the NC DOT is embarking on a feasibility study on "managed lanes" for Wake and Durham Counties. The study will explore both HOV and toll lanes as a revenue and congestion mitigation strategy.²⁹ Qualified plug-in electric vehicles are exempt from annual state emissions inspection requirements. This fee in North Carolina is \$30.³⁰

North Carolina currently has three grant funded projects which are benefiting the PEV market: the Carolina Blue Skies and Green Jobs Initiative (CBS), the Plugging In: Mountains to Sea Project (M2S) and the Clean Fuel Advanced Technology (CFAT) project. The CFAT project, administered by the NC Solar Center/NC State University and funded by the NC Dept. of Transportation, focuses on reducing transportation related emissions in 24 non-attainment and maintenance counties for National Ambient Air Quality Standards. Projects that are adjacent to areas may also be

²⁸ Senate Bill 194, NC General Assembly. Accessed October 5, 2012.

<http://www.ncleg.net/gascripts/BillLookup/BillLookup.pl?Session=2011&BillID=s194> .

²⁹ Contact Joey Hopkins, NCDOT Division 5 for more information.

³⁰ Visit <http://www.ncdot.gov/dmv/vehicle/registration/inspection/> for more information. See also:

http://daq.state.nc.us/motor/inspect/emission_faqs.html#G14

eligible if the project will reduce emissions in eligible counties. Funding is available to offset up to 80% of the cost of AFVs and refueling infrastructure (including PEVs and EVSE). A total of \$6.2 million has been budgeted for education, outreach and emission reduction technology sub-award projects for 2013-2015.³¹ Both the CBS and the M2S projects are funded through the U.S. Dept. of Energy (DOE). The CBS project will expire in 2014 and the M2S and the end of 2012. (Refer to pages 7, 11, and 16 for related information on these projects)

South Carolina

In May of 2012 South Carolina approved an amendment to a 2007-2011 PEV tax credit extending the credit from 2012-2017 and providing clarifying language regarding eligibility. A \$2,000 income tax credit is available for in-state purchase or lease of plug in hybrid electric vehicles (PHEVs) with a minimum of four kilowatt hour of battery capacity that uses an external energy source to recharge the battery. All electric vehicles are currently not eligible for the credit. The credit went into effect on August 1st, 2012 with no sunset date. However, the credit is capped at \$200,000 (maximum 100 vehicles) annually and will be administered in a to-be determined manner.

EVSE deployment in SC has been supported with federal American Reinvestment and Recovery Act (ARRA) funding received by NC based Triangle J Council of Governments for the Blue Skies Green Jobs Initiative and PEV planning grant received by GA's Center for Transportation and the Environment.

Tennessee

Tennessee (TN) has several synergistic components to support robust PEV utilization: passenger PEV manufacturing, state incentives, and federal support. The 2013 Nissan Leaf will be manufactured in Tennessee. The Japanese firm has invested an estimated \$1.6 billion in establishing the Smyrna facility as home for North American Leaf production, split between upgrading its existing production lines and building a brand-new battery factory.

Two primary incentives/projects are spurring TN PEV adoption; a \$2,500 PEV rebate and free EVSE installation of residential and commercial units through the U.S. DOE supported EV Project. Through the EV Project, ECotality offers EVSE at no cost to individuals in the Nashville, Knoxville, Memphis, and Chattanooga metropolitan areas that agree to anonymous data collection after installation. According to the EV Project, as of Aug 30th, 2012 there were a total of 675 residential and 592 commercial Blink Network EVSE installed in Tennessee. ECotality is receiving \$114.8 M from the U.S. DOE for the EV Project to install EVSE in 25 U.S. urban areas, study usage patterns, infrastructure effectiveness and pilot various revenue streams for commercial and public EVSE in order to streamline and enhance PEV deployment. The lion's share of the project's EVSE deployment will be in Tennessee as compared to other nearby states/urban areas participating in the project: GA (Atlanta metro) has 11 commercial and residential EVSE deployed; MD (DC metro) has 81 deployed, VA (DC metro) has 93 deployed.

In September of 2010, the State of Tennessee announced \$2.5 million for the EV Rebate Program. A \$2,500 rebate is available to the first 1,000 Tennessee residents that qualify for and participate in the national DOE EV Project and purchase either a Nissan LEAF SL model car with DC Fast Charge capabilities or a Chevrolet Volt. The GM Volt was not added to the program until FY 2012, as Tennessee was not one of the markets for GM's early deployment.

Between September 2010 and June 30 2011, the EV Rebate Program coordinated with Nissan by registering dealers for participation. By the end of the calendar year for 2011, Tennessee had paid 179 rebates and as of June 30, 2012 the state had paid 340 rebates for both of the Leaf and Volt. By early July 2012, there were 602 PEVs registered in TN. The

³¹ Anne Tazewell, Clean Transportation Program, NC Solar Center. Accessed October 31, 2012, <http://ncsc.ncsu.edu/index.php/clean-transportation/clean-transportation-projects/>.

discrepancy between the number of PEVs and the number of rebates is attributed to Nissan purchasing a large number of Leafs for employee use not eligible for the rebate.

Tennessee also allows HOV access to all Inherently Low Emission Vehicles or Low Emission and Energy-Efficient Vehicles (not just PEVs) as determined by the U.S. EPA that have gross vehicle weight ratings of 26,000 pounds or less.

Virginia

Virginia offers HOV access to PEVs that purchase an alternative fuel license plate at an additional cost of \$25 over standard plates. In addition, EVs registered in Virginia are subject to a \$50 per vehicle annual license tax. PEV planning, education and policy in the Richmond area is being supported through a \$429,051 grant from the U.S. DOE to the Virginia Department of Mines, Minerals and Energy. Dominion Virginia Power provides time of use (TOU) rate options for PEV owners that include installation of a dedicated meter for the PEV and a whole house TOU rate that does not require a separate meter.

The following table summarizes the incentives in place in neighboring and nearby states to North Carolina.

Table 1: GA, MD, NC, SC, TN, VA PEV Incentive Summary Table

State Population ³² Vehicle Registrations ³³	Rebate	Tax Credit (vehicle and/or infrastructure)	PEV Funding : Grants	HOV /Toll Road Access, Alt Fuel License plate	PEV electricity rate- time of use (TOU)	Number of PEVs(as of 6/31/12- 8/15/12) & EVSE
Georgia Pop. 9,687,653 Registrations 4,134,274		\$5,000 vehicle Up to \$2,500 EVSE	DOE Planning; *EVSE (Atlanta metro)	HOV Access Toll Rd Access Alt Fuels License plate	Residential whole house TOU 11:PM- 7AM for PEV owners	NA 80 tax credit certificates in 2011 *9 ** 98 EVSE
Maryland Pop. 5,773,552 Registrations 2,597,592		Up to \$2,000 vehicle Up to \$400 EVSE	REGGI; *EVSE DC Metro	HOV		439 PEVs *22, **147 EVSE
North Carolina Pop. 9,535,683 Registrations 3,451,087			DOE planning, deployment, NCDOT deployment	HOV		719 PEVs **228 EVSE
South Carolina Pop. 4,625,364 Registrations 1,974,494		\$2,000 vehicle	DOE planning/ deployment			NA **106 EVSE

³² U.S. Census, 2010. Accessed September 5, 2012. <http://2010.census.gov/2010census/data/>

³³ North Carolina State Motor Vehicle Registrations, Table 1098, 1990 to 2009, Motorcycle Registrations and Licensed Drivers by State: 2009 (automobiles, including taxis). Accessed August 23, 2012. http://www.census.gov/compendia/statab/cats/transportation/motor_vehicle_registrations_alternative_fueled_vehicles.html

Tennessee Pop. 6,346,105 Registrations 2,854,803	\$2,500 vehicle		* EVSE	HOV		602 PEVs *592, **233 EVSE
Virginia Pop. 8,001,024 Registrations 3,732,468			DOE planning; * EVSE -DC metro	HOV Alt Fuel License Plate	Options include 2 meters or whole house TOU	300 PEVs *9, **87 EVSE

* = commercial installations provided through DOE supported EV Project as reported by Blink Network 8/30/12 (see appendix)

** = as reported in U.S. Dept. of Energy Alternative Fuel Station Locator Map 10/2/12. NC figure reflects updates by Land of Sky Council of Governments at: <http://www.afdc.energy.gov/locator/stations/>

It is noteworthy that based on 2010 Census population data for North Carolina neighboring and nearby states in which numbers of PEVs registrations are available, that the states with greater penetration of PEVs are those with greater financial incentives. Tennessee has a .0095% ownership of PEVs based on population, whereas Maryland and North Carolina have a .0076% and .0075% respectively. Another correlation can be drawn from the three state examples. PEV related economic activity, such as in- state jobs, is enhanced in states that provide financial incentives to put in use the technology that the jobs are supporting. In a competitive economic climate, businesses are attracted to locate in states that support their product. Nissan is expected to add 1,300 jobs at its Smyrna, Tennessee plant to support manufacturing of the all-electric Leaf³⁴. In Maryland, Chevy already has an electric transmission facility and will build the 2013 Spark PEV in White Marsh, MD. When correlating percentage penetration of PEVs in 2012 as compared to automobiles (including taxis) registered in 2009 in the three states, TN has a .0211% rate of PEVs as compared to overall autos while North Carolina and Maryland have .0208% and .0169% penetration rate respectively.

PEV POLICY RECOMENDATIONS FOR NORTH CAROLINA

Policy recommendations to spur PEV adoption in North Carolina can be grouped into two broad categories on the state level: expanded support for existing programs and public incentives. Enhanced support for programs that can provide or have provided incentives to NC's PEV industry will be considered first since framework is already in place to facilitate implementation. A brief overview of effective and widely used public policy recommendations is followed by additional incentive concepts being adopted in other states that may be considered by NC. Recommendations were derived through research conducted into policies in effect in other states, discussions conducted through meetings of the NC PEV Task Force Incentives and Economic Development Working Group and rankings derived from the Plug-In Vehicle Incentives Survey and the NC PEV Incentives Prioritization Table developed by the NC Solar Center/NC State University.

Existing Programs

Energy Policy Act (EPAct) Credit Banking & Selling Program: Provisions for the Energy Credit Banking and Selling Program were enacted by the 2005 General Assembly through SB1149, approved by the Rules Review Commission in April 2007, and went into effect on May1, 2007. The program provides a mechanism by which funds generated from the

³⁴ Danny King, "Nissan will Tennessee double workers for Leaf, battery-pack ramp up". Accessed Oct 31, 2012 <http://green.autoblog.com/2012/03/09/nissan-will-double-tennessee-workers-for-leaf-battery-pack-ramp/> .

sale of federal EPA credits for state fleet use of alternative fuels are deposited into an Alternative Fuel Revolving Fund (AFRF). Accrued funds must be used to maximize benefits to the state for the purchase of alternative fuel, related refueling infrastructure, and alternative fuel vehicles (AFV) purchases. As of September 2012 a total of \$773,798 was deposited in the AFRF. AFRF monies can be used to purchase PEVs and EVSE for the state fleet. An informal suggestion to the Dept. of Administration to use some of the funds for PEVs and EVSE at train stations in NC urban areas has been made. Having Motor Fleet Management (MFM) purchase PEVs for all NC agencies use at train stations would create a multi-modal transportation option for state employees traveling to Charlotte or Greensboro by providing a way to get to meetings in destination cities when traveling by train. In addition, having MFM purchase PEVs for use in the state motor pool and to lease to various agencies would provide a good opportunity for the state to “lead by example” in adopting clean transportation technologies.

Green Business Fund: The North Carolina Green Business Fund (GBF) ³⁵provided competitive grants to help NC small businesses develop commercial innovations and applications in environmentally conscious technologies and renewable energy products and businesses. Administered by the NC Dept. of Commerce Science and Technology Board it has provided critical startup capital for PEV related businesses expanding into and/or developing and installing recharging options for North Carolina motorists. Currently the GBF does not have any funding to grow PEV related industry in North Carolina.

Mobile Source Emission Reduction Grants: The purpose of the Mobile Source Emissions Reduction Grants (MSERG)³⁶ is to achieve reductions from on- and off- road mobile source related emissions in North Carolina. Since 1995 the grant program administered by the NC Dept. of Environment and Natural Resources Division of Air Quality has provided funding to scores of projects that have advanced the use of alternative transportation fuels across the state. Funding for this grant program is subject to availability of state funds and for the past several years has been curtailed.

Existing state run grant programs could be expanded to provide needed incentives to spur growth of PEV adoption in North Carolina’s public and private sectors. Grants to offset a portion of PEV costs garnered the most favorable rankings when Plug In Vehicle Incentive survey respondents were queried on what types of incentives would be most effective in encouraging the purchase/use of PEVs in North Carolina. A total of 92% (202 respondents) ranked vehicle and recharging equipment grants as extremely effective through the survey conducted by the NC Solar Center in spring 2012.



³⁵ The North Carolina Office of Science and Technology, Department of Commerce, “Green Business Fund”. Accessed October 5, 2012. <http://www.ncscitech.com/grant-programs/green-business-fund>

³⁶ NC DENR, Division of Air Quality, “Mobile Source Emission Reduction Grant”. Accessed October 5, 2012 http://daq.state.nc.us/motor/ms_grants/

Petroleum Displacement Plan requirements³⁷ inserted into the state budget in FY 04-05 require the state fleet to reduce petroleum use by 20% by 2010 with a subsequent inclusion extending the requirement to 2016. A progress report is required annually, however there is little awareness of the requirements or accomplishments to date outside of the reporting fleets and a few invested parties such as the State Energy Office and the NC Solar Center. Legislation providing guidelines and implementation policy that takes into effect the total cost of ownership could serve as an incentive for state fleet adoption of PEVs as well as bring to light other cost savings opportunities through petroleum use reduction.

Recognition programs such as the North Carolina Governor Awards for Excellence³⁸ draw attention to and amplify the accomplishments of state employees that go above and beyond their assigned responsibilities. The annual awards do not currently have a category that supports economic, environment and energy accomplishments brought forth by state employees. Adding an "E3" Award that provides a platform for the economic, environmental and energy enhancements of PEV expansion would raise awareness of PEV opportunities among state personnel.



Since 2007, the Mobile CARE (Clean Air Renewable Energy) awards³⁹ have recognized both public and private sector efforts to reduce transportation related emissions. Currently awards recognize efforts in individual, policy, and technology provider and fleet categories. These could be expanded to provide PEV specific champion awards. Respondents to the Plug In Vehicle Incentives Survey ranked "recognition for your company or organization" as moderately effective in encouraging purchase/use of PEVs in North Carolina. This incentive was also ranked as "easiest to implement" for respondents of PEV Incentives Ranking Table. As one of a

few low cost /no cost incentives brought forth in the process of researching incentives it is recommended that local, state and private sector organization support PEV efforts through recognition awards.

State Policy

Sales and use tax exemptions/reductions are perceived to have a greater effect for less cost to the State. A sales tax exemption or reduction is immediate and automatic at the time of purchase so will have a direct impact on a PEVs "sticker price". The immediacy may push a consumer more who is sitting on the fence about a purchase decision than a tax credit that they will have to wait for. Further, a tax credit often carries a higher cost to the state than a sales and use tax exemption. For example in the U.S. case study states cited in this paper, GA, MD, and SC all offer an income tax credit with maximums ranging between \$2,000 and \$5,000 while North Carolina's highway use tax (HUT), which is used in place of a sales tax, is 3% of the vehicle purchase price. For a \$41,000 PEV such as the Chevy Volt the HUT equates to \$1,230 added to the cost of the vehicle. Eliminating the HUT will cost less than one half of a \$2,000 tax credit to the state. A Faculty Research Working Paper Series study conducted by Harvard University estimates that a " sales tax waiver of mean value (\$1,037) is associated with more than twice as large a demand effect as a tax credit of mean value

³⁷ "Petroleum Displacement Plan & Clean Transportation Initiatives," NC Solar Center. Accessed October 5, 2012 <http://ncsc.ncsu.edu/index.php/clean-transportation/clean-transportation-projects/clean-transportation-initiatives/>.

³⁸ "Governor's Awards for Excellence," accessed October 31, 2012

<http://www.governor.state.nc.us/eTownhall/Blog/post/2010/01/25/Governore28099s-Awards-for-Excellence.aspx>

³⁹ "NC Solar Center Clean Fuel Advanced Technology Project". Accessed October 31, 2012 <http://ncsc.ncsu.edu/index.php/clean-transportation/clean-transportation-projects/clean-fuel-advanced-technology-project/>

(\$2,011)⁴⁰. Eliminating or reducing the HUT is recommended for North Carolina and would do more to stimulate PEV purchase rates at less expense.

Vehicle Rebates, either point of sale or mail-in, are widely ranked as effective in supporting vehicle purchases. Of the states surveyed as part of this analysis, Tennessee is the only state that has a point of sale rebate. It also has the greatest penetration of PEVs per capita and per auto registrations of case-study examples. Respondents of the PEV Fleet Survey and the PEV Prioritization table both rank rebates as extremely effective. Forty-six percent of PEV Fleet Survey respondents attributed rebates as extremely effective, almost tying with vehicle grants as the most effective way to spur industry growth. The State of Illinois through its Green Fleet Program has been effectively providing vehicle rebates for all alternative fuel vehicles (AFVs) since 1998. Over \$6 million in rebates has been issued through 2011 for the implementation of over 8,000 AFVs statewide. Illinois offers up to \$4,000 or 10% of the total purchase price to offset a portion of the incremental costs of PEVs as compared to conventional vehicles. Funding for this program comes from a \$20 additional license plate renewal fee on private fleets with 10+ vehicles. The program currently has an annual cap of \$1million. Tennessee offers a \$2,500 rebate on Nissan Leafs and Chevy Volts. A \$2,000 rebate is recommended for North Carolina to increase PEV adoption rates.

Electric Vehicle Service Equipment (EVSE) Tax Credits for businesses. Incentives for EVSEs need to co-exist with incentives for PEVs as both technologies are critical for successful deployment of PEVs. Currently, six U.S. states offer a tax credit for EVSEs. A tax credit of up to 35% of the EVSE equipment and installation costs up to \$1,000 is recommended for businesses in North Carolina. Tax credits are ranked high by respondents to the PEV Prioritization Table, however they are considered by researchers as less effective than a more immediate point of sale or mail in rebate. Tax credits also depend on an applicant's tax liability, hence are perceived as more uncertain or unknown. Nonetheless, the existing (set to expire January 1, 2013) *NC Tax Credit for Alternative Fuel Refueling infrastructure (NCGS 105-129.16D)* for biodiesel and ethanol (E85) refueling equipment could be expanded to include EVSE.

Revenue neutral “feebate” opportunities include mechanisms by which incentives such as rebates, grants and/ or HUT elimination/reductions are offset or paid for by a slight increase in costs for related services provided by the state. For example, North Carolina SB 1038/HB 1595 Mobile Source Emission Reduction bill ⁴¹ sponsored by Senator Clark Jenkins during the 2005-06 General Assembly proposed a \$1.00-\$2.00 increase in annual motor vehicle registration fees depending on a vehicles emissions and fuel economy ratings to provide funding to the State Energy Office to administer a grant program to support purchase of alternative fuel vehicles. It is recommended that any incentives provided by North Carolina be offset by an increase to a transportation related fee such as the annual motor vehicle registration fee. Another example of a potential fee-bate opportunity is to amend the 2011 HB585⁴² which exempts model year vehicles that have driven less than 70,000 miles and are less than three years old from annual emissions exemption. A modest surcharge of \$1-\$5 based on a vehicle's emission ratings could be added to those vehicles whose owners now will be accruing a \$30 annual savings from not paying for the emissions inspections. The surcharge funds could go to support an alternative fuel vehicle grant program administered by the Division of Air Quality or the State Energy Office. Local governments could adapt this strategy by imposing a greater personal property tax for vehicles with poor emissions and

⁴⁰ Kelly Gallagher and Erich Muehlegger, *Giving Green to Get Green: Incentives and Consumer Adoption of Hybrid Vehicle Technology (page 6)*, Kennedy School of Government Working Paper, February 2008.

⁴¹ General Assembly of North Carolina Session 2005 Senate Bill 1038. Accessed October 31, 2012

<http://www.ncga.state.nc.us/Sessions/2005/Bills/Senate/PDF/S1038v1.pdf>

⁴² North Carolina General Assembly, H585: “An Act to Exempt Vehicle of the Three Newest Model Years with Less than Seventy Thousand Miles from Emission Inspections,” (2011). Accessed October 31, 2012.

<http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2011&BillID=H585> .

fuel economy to offset a reduced rate for vehicles that offer cleaner emissions and higher fuel economy. This would benefit PEV adoption at the same time as not increasing costs to the state/local government.

NC PEV Taskforce- Formation of an Implementation Working Group: An implementation working group is recommended to facilitate the implementation of the NC PEV Roadmap (Readiness Plan) created as part of the NC PEV Initiative: Plugging-in from Mountains to Sea, funded through the U.S. Department of Energy. The formation of an implementation working group will ensure a consistent and structured approach to the implementation of the NC PEV Roadmap. Members of the group would consist of: representatives of the NC PEV Task Force Steering Committee lead by NC Dept. of Commerce and Advanced Energy, members of the various Task force Working Groups including elected officials, PEV industry representatives, state agencies, utility representatives, academic and consumer interests. The implementation working group may begin operations as part of the NC PEV Task Force Steering Committee and may transition into a separate group if needed.

Additional Considerations

Time of use (TOU) rates for PEV owners are being considered by utilities. Whole house TOU rates treat all loads within a home, including a plug-in vehicle, equally and are used to shift electricity usage to off –peak (less expensive) times. The major investor owned utilities in North Carolina including Duke Energy Carolinas, Progress Energy Carolinas, and Dominion North Carolina Power all offer versions of a whole home TOU rate. Some utilities also offer specific TOU rates for PEV owners that require the installation of a second meter. Dominion Virginia Power (DVP) offers both whole-house and EV-only TOU rates. DVP’s EV-only TOU rate provides an option for customers who cannot modify their entire household energy consumption to shift only their charging behavior to off-peak periods. Under DVP’s EV-only TOU option, each individual customer has the opportunity to decide whether the cost of a second meter justifies segregating their charging load. While it is a desired goal to promote off-peak vehicle charging whenever feasible, it should be noted that the incremental fuel savings for a vehicle charging completely under a TOU rate is still relatively minor due to the standard electricity rate providing a savings of approximately 75% compared to gasoline. Moving forward, it’s recommended that the availability of TOU rates be included in education and outreach activities and that utilities begin to assess how PEVs may or may not affect the design of whole house or PEV-only TOU rates.

Vehicle manufacturer discount for U.S. Dept. of Energy Clean Cities stakeholders would provide a positive link between companies producing PEVs and a national government agency promoting alternative fuel vehicles. A \$750 discount for purchase of a PEV that would be applied by the dealer at the point of sale would mirror a similar discount provided for membership to the National Homebuilders Association. The U.S. Dept. of Energy Clean Cities program, a national network of over 85 coalitions, could leverage its thousands of stakeholder relations across the country with its equally strong relations with vehicle original equipment manufacturers to facilitate the creation of this incentive. Once established it could be promoted through the Clean Cities network.

Encourage dealers to take federal tax credit and pass on savings to tax exempt fleets⁴³. IRS tax code provides ability for dealer to claim current \$7,500 tax credit for vehicles sold to tax exempt entities such as state and local

⁴³Refer to page 3 of IRS tax document :<http://www.irs.gov/pub/irs-pdf/f8834.pdf> which states, “Exception: If you are the seller of a qualified plug-in electric vehicle to a tax-exempt organization, governmental unit, or a foreign person or entity, and the use of that vehicle is described in section 50(b)(3) or (4), you can claim the credit, but only if you clearly disclose in writing to the purchaser the amount of the tentative credit allowable for the vehicle (from line 11 of Form 8834).

government fleets. The dealer has to have a large enough tax appetite to take the incentives. The claimant of the credit does not have to be the title holder to the electric vehicles but rather the dealership itself. Dealerships can sometimes be unaware of this provision. It is recommended that North Carolina stakeholders identify eligible dealers and promote this potential incentive to eligible fleets.

Special alternative fuel license plates, a reduction in car rental taxes/fees for renting PEVs, reduction in toll road charges, free work place charging are additional policies being implemented across the U.S that could be considered for North Carolina. Refer to appendix for proposal for special alternative fuel license plate.

CONCLUSION:

For PEV adoption to succeed it is important for all parties that have a stake or stand to benefit from more widespread use to provide incentives. The State of North Carolina stands to benefit because more widespread use of PEVs will improve air quality, enhance transportation energy diversity and encourage more PEV related business development. North Carolina utilities stand to benefit when more electricity will be used. Incentives can drive the market, improve quality of life and enhance the total cost of PEV ownership. Policies that reduce the overall cost of ownership of PEVs over internal combustion engine vehicles will lead to faster market adoption. Hence, economic development will be supported at the same time as providing North Carolina citizens an enhanced opportunity to drive the future.

APPENDIX:

- Fleet Incentives Survey
- Incentive Prioritization Table
- PEV Ranked Incentives Table
- PEV Industry List
- PEV Industry Cluster Map
- U.S. PEV Policy Case Studies Background
- PEV License Plate Proposal
- National Conference of State Legislature, Incentives by State

Refer to attached PDF files.

Plug-In Vehicle Incentives Survey



How interested is your organization in purchasing plug-in electric vehicles (PEVs)?

		Response Percent	Response Count
Already Have PEVs		19.8%	48
High Interest		19.4%	47
Moderate Interest		16.1%	39
Some Interest		32.6%	79
No Interest		12.0%	29
		answered question	242
		skipped question	3

Rate the following barriers for adopting PEVs into your fleet?

	Very Important	Moderately Important	Slightly Important	Not important	Don't know	Rating Average	Response Count
Initial purchase price	71.9% (174)	16.9% (41)	5.0% (12)	2.1% (5)	4.1% (10)	1.50	242
Unproven/new technology	30.2% (73)	31.0% (75)	24.8% (60)	9.1% (22)	5.0% (12)	2.28	242
Maintenance training	31.0% (75)	31.4% (76)	19.0% (46)	13.6% (33)	5.0% (12)	2.30	242
Lack of vehicle choice	26.4% (64)	34.3% (83)	22.7% (55)	9.9% (24)	6.6% (16)	2.36	242
Permitting process	16.1% (39)	18.2% (44)	23.1% (56)	26.0% (63)	16.5% (40)	3.09	242
Other (please specify)							25
answered question							242
skipped question							3

Plug-In Vehicle Incentives Survey



Rate your organization's interest in each of the following:

	Extremely interested	Very interested	Moderately interested	Slightly interested	No interest	Don't know	Rating Average	Re
Environmental Impacts (Air Quality, Carbon Emission Reductions)	41.8% (99)	38.0% (90)	14.8% (35)	3.0% (7)	0.8% (2)	1.7% (4)	1.88	
Energy Security/Energy Independence (Alternative Fuels/Fuel Diversity)	33.3% (79)	44.7% (106)	13.5% (32)	3.4% (8)	3.0% (7)	2.1% (5)	2.04	
Economy/Efficiency (Fuel Cost Reductions, MPG Improvement, Route Optimization)	59.9% (142)	32.1% (76)	5.9% (14)	0.0% (0)	0.4% (1)	1.7% (4)	1.54	
Promotion/Corporate Marketing ("green" image)	22.4% (53)	36.3% (86)	24.1% (57)	10.5% (25)	5.1% (12)	1.7% (4)	2.45	
answered question								
skipped question								

Has your organization adopted policies that encourage PEV adoption? Check all that apply.

		Response Percent	Response Count
Purchasing policy that takes into account the full cost of ownership (vehicle price, fuel and maintenance costs)		21.5%	51
Corporate or organizational sustainability policy		34.6%	82
"Green" or environmental fleet policy		24.9%	59
None/NA		54.9%	130
	Other (please specify)		10
		answered question	237
		skipped question	8

What is the average daily mileage per vehicle in your fleet (based on annual usage)?

		Response Percent	Response Count
30 miles or less		27.6%	63
30-50 miles		22.8%	52
50-100 miles		15.4%	35
100+ miles		13.6%	31
Don't track vehicle miles		3.9%	9
Don't know		16.7%	38
answered question			228
skipped question			17

Do a majority of your vehicles return to a common parking area daily?

		Response Percent	Response Count
Yes		74.6%	173
No		22.8%	53
Don't know		2.6%	6
answered question			232
skipped question			13

What is the average number of years a vehicle is utilized in your fleet?

		Response Percent	Response Count
1-3 years		3.9%	9
4-6 years		22.8%	53
7-9 years		31.9%	74
10 or more years		33.6%	78
Don't know		7.8%	18
answered question			232
skipped question			13

Are you willing to consider a vehicle that has a higher initial purchase price if you can later recoup the extra cost through fuel and maintenance savings?

		Response Percent	Response Count
Yes		73.4%	168
No		7.4%	17
Don't know		19.2%	44
answered question			229
skipped question			16

Would your organization consider purchasing a PEV that initially cost more than a conventional vehicle, if there were a financial incentive to recoup a certain percent of the price difference between the PEV and conventional vehicle:

	Yes	No	Response Count
Up to 30% of the difference	47.2% (108)	52.8% (121)	229
Up to 60% of the difference	68.6% (157)	31.4% (72)	229
Up to 100% of the difference	83.0% (190)	17.0% (39)	229
answered question			229
skipped question			16

What types of incentives do you think would be most effective in encouraging the purchase /use of PEVs in North Carolina?

	Extremely effective	Very effective	Moderately effective	Slightly effective	Not at all effective	Rating Average	Response Count
Vehicle tax credits	28.7% (62)	29.6% (64)	17.6% (38)	11.6% (25)	12.5% (27)	2.50	216
Recharging Infrastructure tax credits	22.2% (47)	30.7% (65)	22.6% (48)	14.6% (31)	9.9% (21)	2.59	212
Vehicle purchase price rebates	46.1% (100)	38.7% (84)	9.2% (20)	1.8% (4)	4.1% (9)	1.79	217
Grants to offset a portion of the purchase price of vehicles	48.9% (108)	36.2% (80)	9.5% (21)	2.7% (6)	2.7% (6)	1.74	221
Grants to offset a portion of the cost of PEV charging equipment	42.9% (94)	33.3% (73)	16.9% (37)	4.1% (9)	2.7% (6)	1.90	219
Recognition for your company or organization	10.6% (23)	16.1% (35)	38.2% (83)	23.5% (51)	11.5% (25)	3.09	217
Cost reductions in fuel and vehicle maintenance	43.6% (96)	34.1% (75)	16.4% (36)	5.0% (11)	0.9% (2)	1.85	220
					Other (please specify)		9
					answered question		224
					skipped question		21

NC PEV Incentive Prioritization

Incentive Type (<i>Refer to endnotes for detailed information on specific incentive</i>)	Perceived level of effectiveness to spur more rapid PEV adoption in NC (Rank 1 -5 with 5 being the most effective)	Feasibility (Rank 1-5 with 5 being the most feasible)	Priority to be recommended for 2013 legislature(1 -5 with 5 being the most important)	Long term priority (mark x)	Easiest to implement (rank 1-3, with 3 being the easiest)	Comments/Notes/ Steps needed to implement
Manufacturer PEV credit for membership to Clean Cities Coalition (\$750) ¹	2.8	2.9	2.4	x	2	Are manufacturer orders the key; not huge fee/value, seems feasible, gives priority. ; I like this. Prices set by dealer and they are unlikely to participate.
Consumer demand/response benefit ²	2.2	1.6	2	x	1.4	Will take years to implement; complex issue; Not ready for Prime Time; Comments about the benefits being only a small amount of electricity were important.; The technology is still probably 3-5 years out.; Two way energy flow isn't commercially available yet; demand response is but would be small and isn't enough to justify for utility; Dealers looking at it. Technically it's easy. A lot of work w/ auto OEM and battery manufacturers needed to make this a reality
Vehicle rebates ³	4.8	3	3.1	x	2.2	Not ready; State Appropriations? If government had money, easy to do and short term effective. Successful so far, any way to lower cost on end-user is great, legislation probably does not want to keep giving rebates, easy to implement.; Illinois offering now; run through EPA/Clean Cities; up to 80% incremental cost or capped at \$10,000; not a long term strategy

NC PEV Incentive Prioritization

For Individuals and Business								
Tax credit (\$2,000 for purchase of BEV or PHEV) ⁴	4.7	3.4	3.5	x	2.3	Difficult with this G.A.; This would catch NC up to other states' programs ; Only for those that have tax liability		
NC vehicle highway use tax reduction (reduce from 3% to 1.5%) ⁵	3	2.6	2.5	x	1.9	Doesn't seem popular; Small perceived difference, high political cost; This could have a negative backlash effect but would be easy to implement; Why half? Do all 3%-you list much more value for tax credit/rebate. Make into Fee-bate program for motor vehicle registration, no fiscal impact. \$2 more for ICE/ \$2 less for PEVs, for example.		
PEV time of use utility rate ⁶	2.9	2.4	2.2	x	1.5	Lots of hurdles, Little benefit; Requires Utility support; Even non-TOU rate is inexpensive, and utilities already have TOU rate plans that would work well for EVs. In areas where special PEV TOUs are available they are not overly effective		
Free/reduced toll road access	3.2	3.8	3.4	x	2.3	Tolls already seen as poor funding generators i.e \$ 0.40 bills in mail; NCDOT would need big push; The audience is small (hence the "3" in effectiveness) but for the target market in the Triangle area, I think this would have a dramatic effect ; Just don't have many tolls to make use of.		
Utility provided customer credits for	3.6	2.8	2.6	x	2.2	Could be powerful incentive.; Once a potential customer starts to investigate the		

NC PEV Incentive Prioritization

installation of EVSE (\$1,000)									costs of EVs, the EVSE cost will become a huge concern. This would go a long way to removing that barrier. PUC frowns upon incentives, not cost effective; Tax credits could potentially keep prices high. Cap # sold/time limit. Tech cost is coming down quickly.
Eliminate sales tax for EVSE ⁷	2.7	2.9	2.6			x	1.6		Don't want to add elitest image of PEVs; Would rather see the rebate/credit, but this would not be too bad.; Not sure how to do value, low < \$50
Tax credit for EVSE (\$750)	3.9	3.3	3.4			x	2.6		Modify previous 15% Biofuels Refueling Infrastructure Credit - increase to 35%; Be careful to avoid the unintended consequences of having the EVSE tax credit be mutually exclusive with the PEV tax credit.
Free/"reserved" parking for PEVs	2.9	3.5	2.4			x	2.6		More important to reserve spaces at EV charging stations; Reserved parking is important; People just care about getting a spot they can charge their car in not that it is priority; The charging station at the Raleigh Amphitheater is a great example of this perk, provided it is adequately enforced. This should be an incentive promoted at the local level. Don't want to highlight unused EVSEs; Problem enforcing preferred parking spots. Reduced cost of charging stations— and POWER—is needed.
PEV specialty license plate ⁸	2.8	3.8	2.8			x	2.6		Seen by Legislature as voluntary tax, should be more politically acceptable ; Tough to get but helps market PEVs; Not sure how such a

NC PEV Incentive Prioritization

PEVs						Institute idea)
Waive taxes/fees for EVSE installations at business locations						No need for businesses to provide charging—can be done at home or @ fleet locations; Want to be seen that EVs are paying fair share.
Reduce cost to produce PEV						
Raise gas and diesel TAX						Difficult at federal level, and even more difficult for NC until VA and SC achieve parity.

For any questions or to submit form, contact the Clean Transportation Program at the NC Solar Center, cleantransportation@ncsu.edu

¹ For example General Motors offers \$750 price reduction (through dealers) to vehicle purchasers that are members of National Homebuilders Association

² Consumer demand response is the ability for a PEV battery to supply energy to offset some household electrical use during peak hours and then be able to recharge off peak. For example: your EV still has 50% charge after returning home for the day so when you plug in, the current is reversed to draw power from battery for running your dryer or electric stove at the same time. EV is then programmed to recharge off peak hours

³ Up to 80% of the incremental cost of an PEV; for vehicles that have no conventional counterpart, rebate is equal to 10% of MSRP up to \$4,000 <http://www.illinoisgreenfleets.org/fuels/index.html>

⁴ This tax credit could be offset with a slight increase in annual motor vehicle registration fees.

NC PEV Incentive Prioritization

- ⁵ For an EV that costs \$40,000 this represents a savings of \$600. NC Highway Use Tax is equivalent of 3% sales tax and is imposed with vehicle title transfers
- ⁶ Both of NC's largest utilities (Duke & Progress) offer whole house time of use (TOU) rate programs for residential customers that can provide PEV owners that charge off peak approx. \$100 in annual savings. TOU rates include demand charges and reduced on-peak and off-peak electricity rates. Demand charges are factored by billing based on a customer's greatest amount of electricity in 15 minute used increments at any given time within a month. For example if someone was to take a hot shower, dry clothes and charge their PEV this will create a spike in demand charges. Demand charges create uncertainty for monthly billing unless electric use is anticipated and regular. Calculations are required to determine if current TOU rates will benefit for each particular customer PEV owners.
- ⁷ Current state sales tax in NC is 5.75 %.
- ⁸ Funds raised from "Friends of EVs" license plates can go to support statewide DC "fast charging" and/or other related activities.
- ⁹ For public and private locations in NC (providing signage, installation, etc.) to expand charging station installation rate <http://adoptacharger.org/>
- ¹⁰ See page 3 of the tax document from the IRS: <http://www.irs.gov/pub/irs-pdf/f8834.pdf> "Exception. if you are the seller of a qualified plug-in electric vehicle to a tax-exempt organization, governmental unit, or a foreign person or entity, and the use of that vehicle is described in section 50(b)(3) or (4), you can claim the credit, but only if you clearly disclose in writing to the purchaser the amount of the tentative credit allowable for the vehicle (from line 11 of Form 8834)"

Table: Ranking of Incentives by Working Group on Incentives and Economic Development

	<i>Recommendation</i>	<i>Responsible Party</i>	<i>Time Frame*</i>	<i>Priority Level**</i>	<i>Funding Needed?</i>	<i>Goal of Working Group</i>
R.1	Vehicle Rebates		<i>Short</i>	<i>High</i>		
R.2	Tax Credit		<i>Short</i>	<i>Med</i>		
R.3	HUT Exemption		<i>Short</i>	<i>High</i>		
R.4	Feebate		<i>Short</i>	<i>High</i>		
R.5	PEV Implementation Council		<i>Short</i>	<i>High</i>		
R.6	Rental Car tax exemption			<i>Low</i>		
R.7	Free Parking			<i>Low</i>		
R.8	EVSE Utility Tax Credit		<i>Short</i>	<i>Med</i>		
R.9	EV License Plate		<i>Short</i>	<i>High</i>		

NC Plug In Vehicle Industry Contacts

This industry list is managed by the **NC Solar Center, Clean Transportation Program**.

For inquiries, please call Anne Tazewell 919-513-7831

Employer	City	County	State	Type
ABB, Inc.	Raleigh	Wake	NC	smart grid
Ascon Controls, Inc	Raleigh	Wake	NC	Vehicle, battery or component manufacturer
Atraverda	Charlotte	Gaston	NC	Vehicle, battery or component manufacturer
Azure Dynamics Corporation	Oak Park		MI	Vehicle supplier/distributor
Barloworld Handling LP	Charlotte	Mecklenburg	NC	Vehicle supplier/distributor
Biowheels RTS	Asheville	Buncombe	NC	Vehicle supplier/distributor
Blecker Electric Car Company	Fayetteville	Cumberland	NC	Vehicle supplier/distributor
Carolina Industrial Equipment, Inc.	Charlotte	Mecklenburg	NC	Vehicle supplier/distributor
Caterpillar Inc.	Cary	Wake	NC	Vehicle supplier/distributor
Celgard	Charlotte	Mecklenburg	NC	Vehicle, battery or component manufacturer
Charlotte Truck Center	Charlotte	Mecklenburg	NC	Vehicle supplier/distributor
Component Systems Inc.	Charlotte	Mecklenburg	NC	Vehicle, battery or component manufacturer
CREE, Power Business Unit	Durham	Durham	NC	EVSE or component manufacturer
Delta Electronics	Research Triangle Park	Durham	NC	Vehicle, battery, or component manufacturer
Delta Products Corporation	Durham	Durham	NC	Vehicle, battery, or component manufacturer
DesignLine USA	Charlotte	Mecklenburg	NC	Vehicle, battery or component manufacturer
DNA Group	Raleigh	Wake	NC	Vehicle, battery or component manufacturer
Eaton Commercial Properties	Raleigh	Wake	NC	EVSE or component manufacturer

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Eaton Corporation	Kings Mountain	Cleveland	NC	Vehicle, battery or component manufacturer
Eaton Corporation	Arden	Buncombe	NC	EVSE or component manufacturer
Electric Scooter City	Raleigh	Wake	NC	vehicle supplier/distributor
Elster Solutions, LLC	Raleigh	Wake	NC	EVSE or component manufacturer
Evatran	Morrisville	Wake	NC	EVSE or component manufacturer
FMC Lithium	Charlotte	Mecklenburg	NC	Vehicle, battery or component manufacturer
Fred Anderson Toyota	Raleigh	Wake	NC	Vehicle supplier/distributor
GE C&I Electrical Distribution	Mebane	Wake	NC	EVSE or component manufacturer
General Electric	Harahan		LA	EVSE or component manufacturer
General Motors	Charlotte	Mecklenburg	NC	Vehicle, battery or component manufacturer
Hubbell Wiring Systems / PEP Station	Raleigh	Wake	NC	EVSE or component manufacturer
Hybrid Technologies (Li-ion Motors C	Mooreville	Iredell	NC	Vehicle, battery or component manufacturer
I-Cubed	Raleigh	Wake	NC	Other
ISE Corp.	Poway		CA	Vehicle, battery or component manufacturer
Latent Energy Systems	Carthage	Moore	NC	EVSE or component manufacturer
Leviton	Raleigh	Wake	NC	EVSE or component manufacturer
M&M Electric Service, Inc.	Gastonia	Gastobn	NC	Vehicle, battery or component manufacturer
Norcross York Energy	Highpoint	Guilford	NC	Vehicle supplier/distributor
NovaCharge	Tampa		FL	EVSE or component supplier/distributor
Michael Jordan Nissan	Durham	Durham	NC	Vehicle supplier/distributor

NC Plug In Vehicle Industry Contacts

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Niyato Industries	Charlotte, Lenoir	Mecklenburg, Caldwell	NC	Vehicle manufacture, conversion
Organic Transit Electric Bikes	Raleigh	Wake	NC	Vehicle, battery or component manufacturer
Praxis Technologies	Raleigh	Wake	NC	EVSE or component supplier/distributor
Petty Enterprises	Randleman	Randolph	NC	Other
Quanta Technology	Raleigh	Wake	NC	smart grid
Rockwood Lithium	Kings Mountain	Mecklenburg	NC	Vehicle, battery or component manufacturer (lithium mining)
Rogers Electric	Charlotte	Mecklenburg	NC	EVSE or component supplier/distributor
Schneider Electric	Cary	Wake	NC	EVSE or component manufacturer
Sensus	Raleigh	Wake	NC	EVSE or component manufacturer
Shealy Electrical Wholesalers	Fuquay-Varina	Wake	NC	EVSE or component supplier/distributor
Siemens	Wendell	Wake	NC	EVSE or component manufacturer
Smart of Cary	Cary	Wake	NC	Vehicle supplier/distributor
Smith Electric	Tampa/St. Petersburg		FL	Vehicle supplier/distributor
Southern Reimage Consultants	Trinity	Randolph	NC	EVSE or component supplier/distributor
SPX	Charlotte	Mecklenburg	NC	manufacturer, supplier, distributor
TEC-CEL	Cary	Wake	NC	Vehicle, battery, or component manufacturer
Thurso Power	Greenville		SC	EVSE or component manufacturer
TT Electronics	Boone	Watauga	NC	Vehicle, battery or component manufacturer
Umicore Battery Recycling	Raleigh	Wake	NC	Vehicle, battery or component manufacturer
Valence	Wake Forest	Wake	NC	Vehicle, battery or component manufacturer

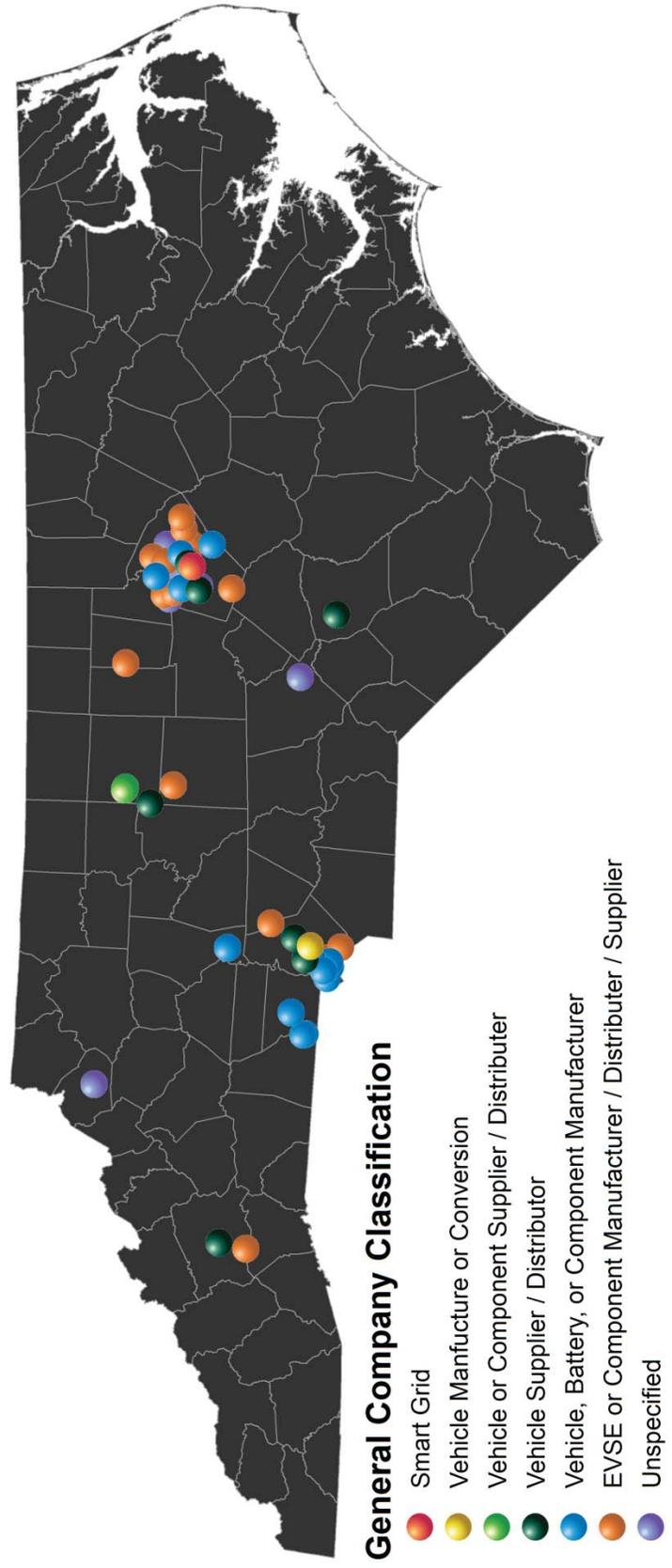
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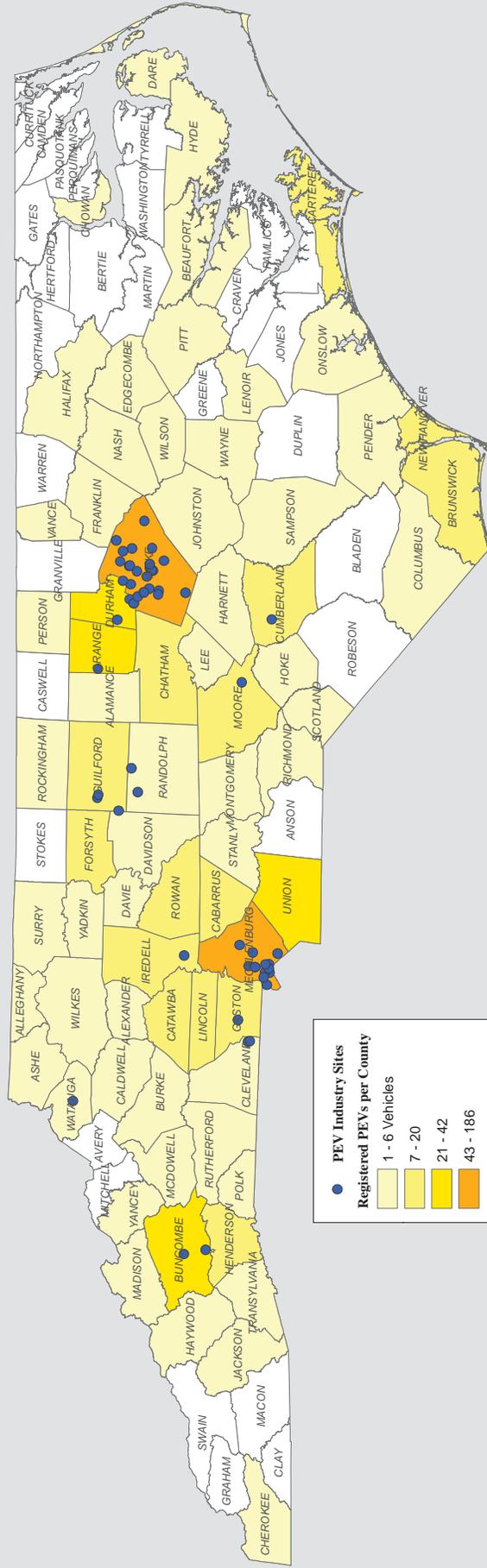
Veritas Economics	Cary	Wake	NC	Other
Volvo	Greensboro	Guilford	NC	Vehicle or component supplier/distributor
White's International Trucks	Greensboro	Guilford	NC	Vehicle or component supplier/distributor
ZAPI Inc.	Garner	Wake	NC	Vehicle, battery or component manufacturer

Key North Carolina Locations with Electric Vehicle Activities



Plug-In Electric Vehicle Industries Located in North Carolina

DRAFT



Data Source: NCDMV

PEV Incentives Case Studies Background: GA, MD, SC, TN, VA

Georgia PEV Incentives

http://www.afdc.energy.gov/laws/state_summary/GA

Zero Emission Vehicle (ZEV) Tax Credit

An income tax credit is available to individuals who purchase or lease a new ZEV. The amount of the tax credit is 20% of the vehicle cost, up to \$5,000. For the purpose of this credit, a ZEV is defined as a motor vehicle that has zero tailpipe and evaporative emissions, including a pure electric vehicle. Low-speed vehicles do not qualify for this credit. Any portion of the credit not used in the year the ZEV is purchased or leased may be carried over for up to five years. (Reference [Georgia Code](#) 48-7-40.16)

Electric Vehicle Supply Equipment (EVSE) Tax Credit

An eligible business enterprise may claim an income tax credit for the purchase or lease of qualified EVSE provided that the EVSE is located in the state and accessible to the public. The amount of the credit is 10% of the cost of the EVSE, up to \$2,500. (Reference [Georgia Code](#) 48-7-40.16)

Point of Contact

James Udi
Environmental Specialist
Georgia Environmental Protection Division
Phone: (404) 363-7046
Fax: (404) 362-2534
james.udi@dnr.state.ga.us

Electric Vehicle Supply Equipment (EVSE) Incentive - ECotality

Through the [EV Project](#), ECotality offers EVSE at no cost to individuals in the Atlanta metropolitan area. To be eligible for free home charging stations, individuals living within the specified area must purchase a qualified plug-in electric vehicle (PEV). Individuals purchasing an eligible PEV should apply at the dealership at the time of vehicle purchase. The EV Project incentive program will also cover most, if not all, of the costs of EVSE installation. All participants in the EV Project incentive program must agree to anonymous data collection after installation. Additional restrictions may apply.

Point of Contact

EV Project Contact Center
ECotality
theevproject@ecotality.com

Plug-In Electric Vehicle Charging Rate Incentive - Georgia Power

Georgia Power offers a [Plug-in Electric Vehicle](#) (PEV) time-of-use electricity rate for residential customers who own an electric or plug-in hybrid electric vehicle. The PEV rate is optional and does not require a separate meter.

Maryland PEV Incentives

http://www.afdc.energy.gov/laws/state_summary/MD

Plug-In Electric Vehicle (PEV) Tax Credit

Purchasers of qualified PEVs may apply for a tax credit of up to \$2,000 against the imposed 6% excise tax. The tax credit is limited to one vehicle per individual and 10 vehicles per business entity. Vehicles must be registered in Maryland, unless the vehicle manufacturer conforms to applicable state or federal laws or regulations governing clean fuel vehicles or PEVs during the year in which the vehicle was purchased, or the vehicle was originally registered in another state. A qualified vehicle must meet the following criteria:

- Has a gross vehicle weight rating not to exceed 8,500 pounds;
- Can achieve a maximum speed of at least 55 miles per hour;
- Is a two-, three-, or four-wheeled vehicle;
- Is propelled to a significant extent by an electric motor that draws electricity from a battery with a capacity of at least four kilowatt hours in the case of a four-wheeled motor vehicle, or at least 2.5 kilowatt hours in the case of a two- or three-wheeled motor vehicle;
- Has not been modified from original manufacturer specifications; and
- Is purchased between October 1, 2010, and July 1, 2013.

(Reference [Maryland Statutes](#), Transportation Code 13-815)

Electric Vehicle Supply Equipment (EVSE) Tax Credit

The Maryland Energy Administration (MEA) offers an income tax credit equal to 20% of the cost of qualified EVSE that meets the definition of qualified alternative fuel vehicle refueling property as set forth in the Internal Revenue Code. The credit may not exceed the lesser of \$400 or the state income tax imposed for that tax year. The tax credit is limited to one EVSE system per individual and 30 EVSE systems per business entity. Individuals and businesses must apply to MEA for the credit. Unused credits may not be carried over. MEA may adopt regulations to limit the credit amounts. Total funds currently available for the tax credit are \$500,000 for the 2012 tax year and \$600,000 for the 2013 tax year. (Reference [Maryland Statutes](#), Tax-General Code 10-729)

Electric Truck Purchase Vouchers

The Maryland Energy Administration provides vouchers for the purchase of new all-electric trucks. Eligible vehicles must have a gross vehicle weight rating over 10,000 pounds and be registered for on-road use in the state of Maryland. Vouchers of \$20,000 are available for qualified vehicles purchased from a dealership in Maryland or directly from a manufacturer located outside of Maryland. Vouchers of \$15,000 are available for qualified vehicles purchased through a dealership located outside of Maryland. All applicants must submit their application for funding by June 15, 2013, limited to five vouchers per motor carrier. The voucher program will end December 31, 2013. For eligibility requirements and application information, see the [Maryland Electric Truck Voucher Program](#) website.

Plug-in Electric Vehicle (PEV) High Occupancy Vehicle (HOV) Lane Exemption

Permitted PEVs may operate in Maryland HOV lanes regardless of the number of occupants. Qualified PEVs must be propelled to a significant extent by an electric motor that draws electricity from a battery with a capacity of at least

four kilowatt hours. To operate in HOV lanes, PEV owners must obtain a permit from the Maryland Motor Vehicle Administration (MVA). The MVA may charge a permit fee of up to \$20 and may issue a limited number of permits. Each year the MVA and the State Highway Administration must report PEV use in HOV lanes to the governor. This exemption expires September 30, 2013. (Reference [Maryland Statutes](#), Transportation Code 25-108)

Electric Vehicle Supply Equipment (EVSE) Incentive - ECOTality

Through the [EV Project](#), ECOTality offers EVSE at no cost to individuals in the Washington, DC metropolitan area. To be eligible for free home charging stations, individuals living within the specified areas must purchase a qualified plug-in electric vehicle (PEV). Individuals purchasing an eligible PEV should apply at the dealership at the time of vehicle purchase. The EV Project incentive program will also cover most, if not all, of the costs of EVSE installation. All participants in the EV Project incentive program must agree to anonymous data collection after installation. Additional restrictions may apply.

Point of Contact

EV Project Contact Center /ECOTality theevproject@ecotality.com

Provision for Plug-In Electric Vehicle (PEV) Charging Incentives

By June 30, 2013, the Maryland Public Service Commission (PSC) must establish a pilot program for electric customers to charge PEVs during off-peak hours. The pilot program must include at least two electric companies and provide incentives for residential, commercial, and governmental customers to charge PEVs. The incentives should increase the efficiency and reliability of the electric distribution system and lower electricity use at times of high demand. The incentives may include time-of-use pricing, credits on distribution charges, rebates on the cost of charging systems, demand response programs, or other incentives approved by PSC. (Reference [Senate Bill 179](#), 2011, and [Maryland Statutes](#), Public Utilities Code 7-21-1)

Plug-in Electric Vehicle (PEV) Infrastructure Promotion

The [Maryland Electric Vehicle Infrastructure Council](#) (Council) promotes the use of PEVs in the state. Specific responsibilities of the Council include the following:

- Develop an action plan to facilitate successful integration of PEVs into the Maryland transportation network;
- Assist in developing and coordinating statewide standards for streamlined permitting and installation of electric vehicle supply equipment;
- Recommend a statewide charging infrastructure plan and incentives to support investment in PEVs;
- Develop targeted policies to support fleet purchases of PEVs; and
- Encourage local and regional efforts to promote the use of PEVs.

The Maryland Department of Transportation must provide staff support to the Council with the assistance of the Maryland Energy Administration and the Maryland Public Service Commission. The Council submitted an interim report and recommendations to the governor, and must submit a final report and recommendations by December 1, 2012. The Council will remain in place through June 2013.

http://www.mdot.maryland.gov/Office%20of%20Planning%20and%20Capital%20Programming/Electric_Vehicle/Index.html

1) What is the estimated Fiscal impact for \$2,000 PEV tax credit (available 2010-2013)?

\$2.5 million has been allocated to tax credit funding which has been supported through funding provided by the State's *Regional Greenhouse Gas Initiative (RGGI) (<http://www.rggi.org/>) allocation. MD residents apply to MD DMV (1/5 of a page application) for the tax credit which are forwarded to MEA who track and make payment

***Statute: Vehicles titled between 10/1/10 and 7/1/13.

	Estimated Tax Credits Per Year (FY)			Total
	2011	2012	2013	
Vehicle	140	470	644	1,254
Actual	75	364	0	439
Budget	\$279,000.00	\$939,600.00	\$1,287,000.00	\$2,505,600.00
Actual Spend	\$148,387.54	\$710,118.20		\$858,505.74
Balance	\$130,612.46	\$229,481.80	\$1,287,000.00	\$1,647,094.26
	53.57%	77.45%		34.26%

*NE RGGI program: The Regional Greenhouse Gas Initiative (RGGI) is the first market-based regulatory program in the United States to reduce greenhouse gas emissions. RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. Together, these states have capped and will reduce CO₂ emissions from the power sector 10 percent by 2018. Utilities purchase allowances. Revenue from auction is distributed by formula which are spent by states for a variety of programs including energy and low income bill payment programs. Legislation was passed that allocated RGGI funds to the specific PEV incentive programs in MD.

3) Has the MEA exhausted funds available for EVSE incentives for 2012? Do you know how much has been obligated of the \$500,000 available for 2012?

Based on calendar years: allocated for 2011 \$400,000, Began in July 2011 awarded 35 tax credits for total of \$7060.58. 2012 allocated \$500k, 2013 allocated \$600K for total of \$1.5M for 3 year program.

Based on experience with Bio-heating Oil tax credit; credit requests typically come in around tax time. Check back after April 2013 to see how much of the credit was utilized for calendar year 2012.

4) How did incentives get passed (i.e who were the champions?)

MEA credits team effort- MEA, Gov office, Baltimore EV Initiative, MD DOT, MD Dept. of Environment, Utilities, OEM and EVSE manufacturers, Chevy already has electric transmission facility in MD and will build Spark EV in Whitmarsh, MD.

5) How is MEA "paying" for the EVSE and Electric Truck Purchase Voucher program?

Voucher program was modeled after CA, now NY has a similar program. Program was administered by MEA with \$500,000 from MDOT through Transportation Trust Fund (revenue generated from registrations, vehicle excise tax, gas tax). Funding is currently not available. Program was very popular with large fleets such as Staples, Fed Ex, Frito Lay and all the \$500,000 has been expended. The idea for the program came about when a manufacturer was considering coming to MD and requested a grant program for \$x amount to incentive customers in MD. The prospective company asked for too much but gave MEA the idea to try something on a smaller scale.

Continuing policy considerations for MD:

- Multi dwelling and dense urban area (town houses and condos are the most challenging) Contact Sam Bingham with City of Chicago as they are doing a lot of PEV related work)
- New initiatives: MD has statutes related to HOAs (i.e prohibiting HOA from banning clothes lines or solar panels). This may be the method the Legislature will choose to help facilitate EVSE in multi-dwellings/condos
- Considering requirements that garages having to be pre wired for EVSE as part of new building permits

6) How effect is access to HOV for EVs as an incentive? Is this well utilized?

Not sure what effect HOV access has played in MD.

7) Has the formation of the Maryland Electric Vehicle Infrastructure Council been an effective non- monetary pathway for infrastructure promotion? Was MD DOT the “driver” for the creation of the council? Was it promoted/endorsed by the governor?

Yes, MEVIC has been very effective. MEA is in the office of Governor. This was a Governor initiative. Edict was to insure a smooth transition to EV. One of the council recommendations will be to extend \$2,000 tax credit. The MEVIC was also responsible for getting following two pieces of legislation:

Electric Vehicle Supply Equipment (EVSE) Regulation Exemption

Effective October 1, 2012, owners and operators of EVSE are not subject to state regulation as electricity suppliers or public service companies. For the purpose of this regulation, owners and operators of EVSE are considered retail electric customers. (Reference [House Bill 1280](#) and [Senate Bill 997](#), 2012; and [Maryland Statutes](#), State Government Code 10-101(a))

This policy means that EVSE operators will not be regulated as utilities. Before this even if you were providing free electricity you could be regulated as a utility. The question of how are you going to sell if not a supplier- still needs to be answered. However, EVSE owners and operators are not prohibited from selling. MD is waiting for National Weights and Measure to come out with recommendations before taking further action.

Plug-in Electric Vehicle (PEV) Information Disclosure

The Maryland Motor Vehicle Administration is allowed to provide the address of a registered PEV owner and information about the vehicle to electric companies for their use. (Reference [House Bill 1279](#) and [Senate Bill 998](#), 2012; and [Maryland Statutes](#), State Government Code 10-616)

This provision has made it easy for to track sales of PEVs in the State. Reasoning for this is information disclosure that grid security and reliability is primary concern of Utilities Commission. Need to provide an easy way to provide reliability info to facilitate utility planning. An alternative to having MMVA report this would be to have folks register, but that would be cumbersome. MD solution is more straightforward

Population of MD: 2011 5.8 M;

Vehicles registered (2009 U.S. Census): 2,598,000 Number of EVs sold as of June 2011 439

Point of Contact Chris Rice
 Maryland Clean Cities Coordinator/ Maryland Energy Administration
 Phone: (410) 260-7207 crice@energy.state.md.us

South Carolina PEV Tax Credit

2007-2011 PEV TAX CREDIT

SECTION 12-6-3376. Income tax credit for plug-in hybrid vehicle.

(A) For taxable years beginning after 2007, and before 2011, a taxpayer is allowed a tax credit against the income tax imposed pursuant to this chapter for the in-state purchase or lease of a plug-in hybrid vehicle. A plug-in hybrid vehicle is a vehicle that shares the same benefits as an internal combustion and electric engine with an all-electric range of no less than nine miles. The credit is equal to two thousand dollars. The credit allowed by this section is nonrefundable and if the amount of the credit exceeds the taxpayer's liability for the applicable taxable year, any unused credit may be carried forward for five years.

(B) Notwithstanding the credit amount allowed pursuant to this section, for a fiscal year all claims made pursuant to this section must not exceed two hundred thousand dollars and must apply proportionately to all eligible claimants.

HISTORY: 2007 Act No. 83, Section 11, eff June 19, 2007.

2012 PEV Tax Credit

http://www.scstatehouse.gov/query.php?search=DOC&searchtext=3059&category=LEGISLATION&session=119&conid=7047471&result_pos=&keyval=1193059&numrows=10

H. 3059 NOTE: THIS COPY IS A TEMPORARY VERSION. THIS DOCUMENT WILL REMAIN IN THIS VERSION UNTIL PUBLISHED IN THE ADVANCE SHEETS TO THE ACTS AND JOINT RESOLUTIONS. WHEN THIS DOCUMENT IS PUBLISHED IN THE ADVANCE SHEET, THIS NOTE WILL BE REMOVED.(A161, R185, H3059)

AN ACT TO AMEND SECTION 12-6-3376, CODE OF LAWS OF SOUTH CAROLINA, 1976, RELATING TO THE INCOME TAX CREDIT FOR PLUG-IN HYBRID VEHICLES, SO AS TO REVISE THE DEFINITION OF "PLUG-IN HYBRID VEHICLE", REVISE THE METHOD OF ALLOCATING THE CREDIT, PROVIDE THAT CERTAIN INFORMATION MUST BE PROVIDED TO THE DEPARTMENT OF REVENUE IN ORDER TO CLAIM THE CREDIT, REVISE ITS EXPIRATION DATE, AND PROVIDE THAT THE CREDIT MUST BE ALLOCATED TO ELIGIBLE CLAIMANTS DURING A FISCAL YEAR ON A FIRST-COME, FIRST-SERVED BASIS.

Be it enacted by the General Assembly of the State of South Carolina:

Plug-in hybrid vehicle tax credit

SECTION 1. Section 12-6-3376 of the 1976 Code, as added by Act 83 of 2007, is amended to read:

"Section 12-6-3376. (A) For taxable years beginning in 2012 and before 2017, a taxpayer is allowed a tax credit against the income tax imposed pursuant to this chapter for the in-state purchase or lease of a new plug-in hybrid vehicle.

A plug-in hybrid vehicle is a vehicle that:

(1) shares the same benefits as an internal combustion and electric engine with an all-electric range of no less than nine miles;

- (2) has four or more wheels;
- (3) draws propulsion using a traction battery;
- (4) has at least four kilowatt hours of battery capacity; and
- (5) uses an external source of energy to recharge the battery.

Qualified plug-in hybrid vehicles also must be manufactured primarily for use on public streets, roads, highways, and not be classified as low or medium speed vehicles. Low-speed vehicles are vehicles capable of a speed of at least twenty but not more than twenty-five miles per hour, is used primarily for short trips and recreational purposes, and has safety equipment such as lights, reflectors, mirrors, parking brake, windshield, and safety belts. Medium-speed vehicles are vehicles capable of a speed of at least thirty but not more than forty-six miles per hour and has safety equipment such as lights, reflectors, mirrors, parking brake, windshield, and safety belts.

The credit is equal to six hundred sixty-seven dollars, plus one hundred eleven dollars if the vehicle has at least five kilowatt hours of battery capacity, plus an additional one hundred eleven dollars for each kilowatt hour of battery capacity in excess of five kilowatt hours. The maximum credit allowed by this section is two thousand dollars. The credit allowed by this section is nonrefundable and if the amount of the credit exceeds the taxpayer's liability for the applicable taxable year, any unused credit may be carried forward for five years.

(B) To claim the credit allowed by this section, the taxpayer must provide the department with a certification from the vehicle manufacturer, or in the case of a foreign vehicle manufacturer, its domestic distributor, stating that the vehicle is a qualified plug-in hybrid as described in subsection (A), and the vehicle's number of kilowatt hours of battery capacity.

(C) Notwithstanding the credit amount allowed pursuant to this section, for a calendar year all claims made pursuant to this section must not exceed two hundred thousand dollars and must apply to eligible claimants on a first-come, first-served basis as determined by the Department of Revenue in a manner it prescribes until the total allowable credits for that calendar year are exhausted."

Time effective

SECTION 2. This act takes effect upon approval by the Governor and applies to in-state purchases and leases made on or after the first day of the calendar month beginning at least thirty days after the effective date of this act.

Ratified the 8th day of May, 2012. Approved the 14th day of May, 2012.

South Carolina information resources:

Catherine Vanden Houten
South Carolina Energy Office
1200 Senate Street, 408 Wade Hampton Bldg.
Columbia, SC 29201
803.737.9852 phone cvandenhouten@energy.sc.gov

Jim (James) Poch | Executive Director Plug In Carolina
127 Sandshell Drive Charleston, SC 29492
[843-743-6736](tel:843-743-6736) www.plugincarolina.org jamesrpoch@gmail.com

1) Can you provide details on the following tax credit that was passed in SC? Alternative Fuel and Advanced Vehicle Tax Credit: Residents who claim the federal vehicle tax credit are eligible for a state income tax credit equal to 20% of the federal credit. <http://www.ncsl.org/issues-research/energyhome/state-electric-vehicle-incentives-state-chart.aspx>

In 2002 SC had a hybrid tax credit that referred to fed tax credits. However, the tax credit that passed in May 2012 is not tied to federal tax credits. Rather it began as \$ 2,000 tax credit with legislation passed in 2007. The 2007 bill was supported by SC Energy Office (hydrogen & plug in vehicle efforts) and expired in 2010

2012 bill H3059 provides up to \$2000 income tax credit based on battery size (Volt is eligible for full \$2,000). Law took effect Aug 1. OEM needs to submit qualifying info to State to verify amount of credit since credit is related to battery capacity.

2) **When did this bill pass?** May 2012

3) **Can you provide reference to bill language?**
http://www.scstatehouse.gov/query.php?search=DOC&searchtext=3059&category=LEGISLATION&session=119&conid=7047471&result_pos=&keyval=1193059&numrows=10

4) **What are the effective dates (is there a sunset or does it just sunset along with federal tax credits)** No sunset

5) **Who were the primary promoters?** Plug In Carolinas (non- profit) a big part of it (Jim Poch PIC's ED in district of influential state rep- Jim Merrill) GM lobbyist also helped.

6) **Estimated Fiscal impact?** The credit is capped at \$200,000 annually. There is a form to claim credit. As of Aug 2012 it is not clear how the credit will be administered, perhaps folks that submit form credit will be granted credit on a first come /first serve bases.

8) **Are there any effective non-monetary incentives in SC?**

Yes, "Greening of Greenville" City of Greenville's comprehensive approach to implementing sustainability practices showed leadership and demonstrated how EV are an important transportation solution. WeGO partnership through Enterprise car sharing program (http://www.greenvillesc.gov/PublicInfo_Events/Admin/NewsPDFs/Car-Sharing.pdf) is successful from consumer point of view because it makes it easy for folks to " try" electric before making the investment to purchase one of their own but the program likely costs the City.

Federal ARRA funding also has provided an important contribution to expanding PEVs in SC
Successful deployment of about 100 + EVSE (most are free) many are at municipal garages in preferred parking places are providing data on charging patterns to system owners. Report given to station owners, and should EVSE operate want they can upgrade free service to charge when demand increases. Upgrading would cost about \$500 per unit, plus cell connection fee (approx \$20 mo) and per transaction fee) As per conversation with Jim Poch- 115 EVSE were put in by Plug In Carolina of these 97 were supported with ARRA funding. Including all charging station at dealers etc total for SC is approx. 175.

Tennessee PEV Incentives

(http://www.afdc.energy.gov/laws/state_summary/TN)

Plug-in Electric Vehicle (PEV) Rebate

Through the state's participation in the EV Project, the Tennessee Department of Revenue (Department) offers a rebate of \$2,500 on the first 1,000 qualified PEVs purchased in Tennessee. The Department will administer the rebate program in cooperation with Nissan's automotive dealerships in the state. Customers will receive the rebate at the time they purchase their vehicle. For additional information, see the State of Tennessee [Electric Vehicle Purchase Rebate \(PDF\)](#) description

High Occupancy Vehicle (HOV) Lane Exemption

Vehicles that the U.S. Environmental Protection Agency defines as Inherently Low Emission Vehicles or Low Emission and Energy-Efficient Vehicles and have gross vehicle weight ratings of 26,000 pounds or less are permitted use of HOV lanes regardless of the number of occupants. Such vehicles must display a Tennessee Department of Revenue decal. (Reference [Tennessee Code](#) 55-8-188)

Electric Vehicle Supply Equipment (EVSE) Incentive - ECOTality

Through the [EV Project](#), ECOTality offers EVSE at no cost to individuals in the Nashville, Knoxville, Memphis, and Chattanooga metropolitan areas. To be eligible for free home charging stations, individuals living within the specified areas must purchase a qualified plug-in electric vehicle (PEV). Individuals purchasing an eligible PEV should apply at the dealership at the time of vehicle purchase. The EV Project incentive program will also cover most, if not all, of the costs of EVSE installation. All participants in the EV Project incentive program must agree to anonymous data collection after installation. Additional restrictions may apply.

Point of Contact EV Project Contact Center ECOTality theevproject@ecotality.com

High Occupancy Vehicle (HOV) Lane Exemption

Vehicles that the U.S. Environmental Protection Agency defines as Inherently Low Emission Vehicles or Low Emission and Energy-Efficient Vehicles and have gross vehicle weight ratings of 26,000 pounds or less are permitted use of HOV lanes regardless of the number of occupants. Such vehicles must display a Tennessee Department of Revenue decal. (Reference [Tennessee Code](#) 55-8-188)

Email conversation with:

Jonathan G. Overly, Executive Director East Tennessee Clean Fuels Coalition

[865-974-3625](tel:865-974-3625) [865-803-7555](tel:865-803-7555) (cell)

Twitter - [@jgoverly](#), [@ETCleanFuels](#)

Facebook - [Overly](#), [ETCleanFuels](#) www.ETCleanFuels.org

Can you provide details on the following PEV incentives in TN ?

- \$2,500 first come first serve rebate for 1st 1,000 Nissan Leafs sold in TN. Is this rebate still available? I BELIVE SO, PERHAPS A COUPLE OF HUNDRED INCENTIVES STILL LEFT. If not can you tell me how quickly it was expended? I am assuming that this funding was included in the overall 2011 state budget bill as it references Senate bill 2090 which is the state budget. Can you shed any light on how

smoothly this was administered through Nissan Dealers throughout the state? THERE WERE SOME HICCUPS AS THEY DIDN'T ORGINALLY SAY YOU HAD TO BE PART OF THE EV PROJECT, BUT THEN THEY DID. Since it was given at the point of purchase did the dealers get allocated a certain percentage of the 1,000 rebates certificate based on their overall dealership size? DON'T KNOW THE ANSWER TO THIS QUESTION, BUT DON'T THINK THERE WAS ANY ALLOCATION. Was all this part of getting Nissan to build plant in TN or did it come after the fact?

- Success of Ecotality infrastructure project: Is there still funding available for installing EVSE? LAST I HEARD THEY HAD REDUCED THE INSTALL COST TO ZERO DOLLARS BUT YOU COULD POSSIBLY STILL GET THE L2 UNITS FOR FREE. STEPHANIE COX OF ECOTALITY HAS NOT ANSWERED QUESTIONS EITHER AT ALL OR IN A TIMELY MANNER FOR MONTHS. Do you know how many home and commercial sites in TN have been installed? Do you have a contact at Ecotality? STEPHANIE IS THE CONTACT –scox@ecotality.com; [615-504-4928](tel:615-504-4928); NOTE THAT SHE COVERS ALL OF CANADA KNOW AND IS COVERING ATLANTA TOO.
- HOV access for EVs: Is this successful (meaning are HOV lanes well utilized? Does this incentive have any " currency" in TN) How many HOV lanes are there in the state. Why was this bill passed? Do you have any history on it? HAVE NO HISTORY. NASHVILLE HAS HOV LANES AND MEMPHIS MIGHT, BUT THAT WOULD BE IT FOR THE ENTIRE STATE SO THERE IS LIKELY LITTLE CURRENCY TO WORKING TO UTILIZE HOV LANES AS AN INCENTIVE... JUST IMPACTS TOO FEW TENNESSEANS. (OTHER MAY THINK OTHERWISE, THAT IS MY 2 CENTS BUT I'VE NOT HEARD OF ANY FOLKS BRINGING UP SUCH A DISCUSSION THAT WASN'T CITY-BASED INCENTIVE.)

<http://www.ncsl.org/issues-research/energyhome/state-electric-vehicle-incentives-state-chart.aspx>

Phone conversation with: Vicki Williams Founder/President Southern Charge

1002 Harrison Pike Cleveland, TN 37311 (423) 472-2862

(423) 244-6048 mobile vicki.williams@southerncharge.com www.southerncharge.com

Vicki is working with national company interested in EVSE installation in parking lots. Southern Charge represents 3 EVSE companies that would like to provide competition to Ecotality in TN

Through EV Project Ecotality provided DC Fast Chargers at no cost to retail outlets (Cracker Barrel) in TN. Since they received additional funds, Ecotality has been "swamped" and has not been able to keep up with planned installation schedules

Note as per Blink Network 8/16/12 website <http://www.blinknetwork.com/locator.html> : Ecotality has 486 EVSE installation planned for TN (mix of DCFC and Level II) but for example only 80 out of 194 planned for Nashville have been installed

As of Aug 2012 Sothern Charge estimates 1,000 PEVs in TN, FL 1,300.

Excerpt from ECotality website: <http://www.theevproject.com/>

On August 5, 2009, [ECotality](#) was awarded a \$99.8 million dollar grant from the [U.S. Department of Energy](#) to embark on this Project. The Project was officially launched on October 1, 2009.

In June 2010, the Project was granted an additional \$15 million by the U.S. Department of Energy. With partner matches, the total value of the Project is now approximately \$230 million.

ECOTality is deploying chargers in major cities and metropolitan areas across the United States. [Chevrolet Volt](#) and the [Nissan LEAF](#) are partners in The EV Project and drivers who qualify to participate receive a residential charger at no cost. In addition, most, if not all of the installation cost, are paid for by The EV Project.

The EV Project collects and analyzes data to characterize vehicle use in diverse topographic and climatic conditions, evaluates the effectiveness of charge infrastructure, and conducts trials of various revenue systems for commercial and public charge infrastructures. The ultimate goal of The EV Project is to take the lessons learned from the deployment of the first thousands of EVs, and the charging infrastructure supporting them, to enable the streamlined deployment of the next generation of EVs to come.

Email from Alan Jones, TN Dept of Transportation Alan.Jones@tn.gov

As of early July, there were 602 electrics (Nissan Leaf) or plug-in electrics (Chevrolet Volt) in Tennessee. I don't know how many of them took advantage of the state \$2,500 rebate. The decision to include the Volt in the rebate program was made after the incentive was first offered.

Tennessee was discouraged by the prohibition on commercial activities in the federal right-of-way. As a result, we did not locate any charging stations at rest areas or Welcome Centers. Through the ECOTality ARRA grant, we did set up about 450 publicly accessible charging units at businesses and government facility locations. We also have 12 DC fast charge units at Cracker Barrel restaurants across the state.

Email from: Molly R. Cripps Director, Energy Division TN Economic & Community Dev.

Office: [615.741.2994](tel:615.741.2994) molly.cripps@tn.gov

In September of 2010, the State of Tennessee announced \$2.5 million for the EV Rebate Program. A \$2,500 rebate is available to the first 1,000 Tennessee residents that qualify for and participate in the national DOE EV Project and purchase either a Nissan LEAF SL model car with DC Fast Charge capabilities or a Chevrolet Volt. The GM Volt was not added to the program until FY 2012, as Tennessee was not one of the markets for GM's early deployment.

Between September 2010 and June 30 2011, the EV Rebate Program coordinated with Nissan by registering dealers for participation. The slower shipment of Nissan LEAF vehicles into the US resulted in 37 applications for rebates and approximately 25 paid. By the end of the calendar year for 2011, Tennessee had paid 179 rebates at \$2,500 each for a total of \$447,500.

By June 30, 2012 the state had paid 340 rebates for both of the vehicles and had approximately 35 outstanding applications likely to be paid within the next 30 days ending the second quarter. Projections indicate the possibility of issuing over 500 rebates by the close of program.

Do you know who the "champions" were that got the state to appropriate \$2.5 M to support the \$2,500 rebate? The decision to provide the rebate was made nearly a year before I began working for the State, so I am not certain as to all of the parties involved. It was, however, intended to support the Nissan LEAF as well as DOE's Electric Vehicle Project. I do not know if the rebate was an incentive to Nissan to locate the LEAF plant in TN, especially considering that Nissan North American headquarters had already relocated to TN and there have been Nissan mfg facilities in TN since the 1980s.

Is the rebate system set up to run through the dealerships running smoothly? Is the Dept of Revenue keeping track and intending to inform all the Leaf and Volt dealers when the funding has been expended?

The rebate system is running fairly smoothly. We will encounter dealerships on occasion that have not been educated about the program by GM or Nissan, but we are able to tackle any questions or route them to the

appropriate persons at GM and Nissan. Sometimes it takes a while for ECOTality to confirm that the VINs for the vehicles are listed as a VINs in the EV Project, but the personnel at ECOTality are responsive to those requests. Dept of Revenue and the Energy Division keep track of the funds. It is unlikely that the funding will be exhausted. At this point, the EV Project has up until December 31, 2012 to register participants.

Do you think other PEVs will be allowed into the program?

Since the rebate program is tied to the DOE EV Project and ECOTality determines eligible vehicles under the EV Project, the State is not in a position to expand the rebate program at this point. Should ECOTality decide to allow other vehicles to qualify for the EV Project in TN, the State will examine whether we support that decision.

What do you think are the most effective state incentives/policies to spur more widespread adoption of PEVs. Since the cars are so expensive, rebates and/or tax credits appear to be the most effective state incentives for consumers. Also, since public charging infrastructure plays a key role, rebates, other financial assistance, and/or tax credits for the installation of such are necessary for continued growth.

8/30/12 Email from Danielle Wentworth

Blink Network Contact Center e: support@blinknetwork.com | d: [+1.888.998.2546](tel:+18889982546)

Total includes both EV Project and commercial sales installations in VA, MD, GA, TN

Blink EVSEs Currently Installed	
VA Residential	VA Commercial
84	9
MD Residential	MD Commercial
79	22
GA Residential	GA Commercial
2	9
TN Residential	TN Commercial
675	592

Email from Thomas Garetson Vice President, Projects

e: tgaretson@ecotality.com | d: [+1.602.345.9020](tel:+16023459020) | f: [+1.602.443.9007](tel:+16024439007)

In short, no we do expect similar deployment as TN in other states that you are surveying.

Firstly, a big part of Tennessee's success has come from a \$2,500 state rebate for plug-in vehicle drivers as well as the less expensive costs for deployment (lower cost labor, lower permitting fees) than most of the other states we are in. Secondly, we have a limited number of units that we will deploy, and there isn't sufficient quantity for these other states to get that many before we meet our limit. And finally, the EV Project scope of study does not officially include any Level 2 non-residential units in the Washington DC market area (VA & MD). A few have gone in in support of some national relationships we have with companies that have deployed blink units throughout the EV Project area, but there will be very few more.

Virginia PEV Incentives

http://www.afdc.energy.gov/laws/state_summary/VA

Retail Electric Vehicle (EV) Charging Regulations

Retail PEV charging services provided by an individual who is not a public utility, public service corporation, or public service company, do not constitute the retail sale of electricity if the electricity is used solely for transportation purposes and the person providing the PEV charging service has procured the electricity from an authorized public utility. The Virginia State Corporation Commission may not set the rates, charges, or fees for retail PEV charging services provided by non-utilities. (Reference [Virginia Code](#) 56-1.2 and 56-232.2:1)

Alternative Fuels and Electric Vehicle (EV) Tax

Liquid alternative fuels used to operate on-road vehicles are taxed at a rate of \$0.175 per gallon. EVs registered in Virginia are subject to a \$50.00 per vehicle annual license tax. (Reference [House Bill](#) 1248, 2012, and [Virginia Code](#) 58.1-2249)

Provision for Alternative Fuel Vehicle (AFV) Tax Reduction

Local governments may reduce personal property taxes paid on AFVs, specifically vehicles that operate using natural gas, liquefied petroleum gas or propane, hydrogen, or electricity, including low-speed vehicles. (Reference [Virginia Code](#) 58.1-3506)

Retail Electric Vehicle (EV) Charging Regulations

Retail PEV charging services provided by an individual who is not a public utility, public service corporation, or public service company, do not constitute the retail sale of electricity if the electricity is used solely for transportation purposes and the person providing the PEV charging service has procured the electricity from an authorized public utility. The Virginia State Corporation Commission may not set the rates, charges, or fees for retail PEV charging services provided by non-utilities. (Reference [Virginia Code](#) 56-1.2 and 56-232.2:1)

High Occupancy Vehicle (HOV) Lane Exemption

Alternative fuel vehicles (AFVs) displaying the Virginia Clean Special Fuels license plate may use Virginia HOV lanes, regardless of the number of occupants. For HOV lanes serving the I-95/I-395 corridor, only registered vehicles displaying Clean Special Fuels license plates issued before July 1, 2006, are exempt from HOV lane requirements. For HOV lanes serving the I-66 corridor, only registered vehicles displaying Clean Special Fuels license plates issued before July 1, 2011, are exempt from HOV lane requirements. Eligible vehicles include dedicated AFVs and some hybrid electric vehicles; see the [Virginia Department of Motor Vehicles](#) website for a complete list of qualifying vehicles. The annual fee for Clean Special Fuels license plates is \$25 in addition to the prescribed fee for commonwealth license plates. (Reference [House Bill](#) 85, 2012, and [Virginia Code](#) 33.1-46.2 and 46.2-749.3)

Electric Vehicle Supply Equipment (EVSE) Incentive - ECOTality

Through the [EV Project](#), ECOTality offers EVSE at no cost to individuals in the Washington, DC metropolitan area. To be eligible for free home charging stations, individuals living within the specified areas must purchase a qualified plug-in electric vehicle (PEV). Individuals purchasing an eligible PEV should apply at the dealership at the time of vehicle purchase. The EV Project incentive program will also cover most, if not all, of the costs of EVSE installation. All participants in the EV Project incentive program must agree to anonymous data collection after installation. Additional restrictions may apply.

Point of Contact EV Project Contact Center ECOTality theevproject@ecotality.com

Email from: Andy Flavin, Alternative Energy Policy Research Analyst, Dominion Resources, Inc.
(804) 819-2826 (p) andrew.j.flavin@dom.com

We do not know the numbers as of July, but in February 2012 Virginia had approximately 300 EV registrations (Volts, LEAFs, and Roadsters). We're hoping to get updated information shortly.

Here is a brochure with information about our EV Pricing Plans: <https://www.dom.com/about/environment/pdf/electric-vehicle-brochure.pdf>.

According to the Department of Energy's Alternative Fuel Data Center, I see 128 public or semi-public EVSE locations in Virginia (as of August 31), many of which contain multiple chargepoints: <http://www.afdc.energy.gov/locator/stations/>. We have no way of knowing the total number or type of residential EVSE level unless an EV owner voluntarily tells us.



PEV License Plate

Proposal

Revise the last item in the September 2012 draft report, Special Alternative Fuel License Plates, to reflect a broader approach to encompass many of the items identified by the Working Group.

This would primarily involve requiring every new PEV owner to procure and display a new license plate. Plate purchase and annual renewal would be higher than that of regular internal combustion engine vehicles.

The annual fee would establish a revenue stream, which while initially small, would grow as market share increases. A portion of fees collected would be allocated to DMV, with the rest available to a group such as the proposed NC PEV Implementation Council, for application toward other efforts identified by the Task Force.

NC DMV issues distinct license plates and collects different fees, for a wide variety of motor vehicles, so the mechanisms are already in place to adopt such an approach.

As market growth increases and technology advances, this funding could be reallocated to respond much more quickly than typical legislative processes, toward advancing programs to achieve long term goals.

The establishment of a higher registration/renewal fee may seem counterintuitive to our mission of incentives, but has advantages in providing a funding source for future initiatives as we transition toward better, cleaner, and more efficient transportation.

Other Benefits

1. Informative – prominently displays the green vehicle usage and owner pride.
2. Tolls – since NC toll roads are equipped for license plate detection, waiving tolls would be easier. PEV owners would not have to purchase a transponder.
3. Tracking – better identification of PEV locations/concentration, including toll road usage.
4. Personalization Option – as with other plates, offer a personalization option for an extra cost.
5. Perception – this would help deflect criticism of any perception of unfair entitlement, i.e. no emission testing, highway use tax, gas tax, etc.

**For more information contact Gil Johnson of Capital Consulting and member of the Working Group on Incentives and Economic Development at giljohnson@mac.com

May 2011

Staff Contact: Julia Verdi

As states look to promote electric vehicles, they are creating a variety of incentives. Twenty-seven states and DC have electric vehicle (EV) incentives for individuals. Thirteen states currently have pending legislation relating to incentives. These incentives include high-occupancy vehicle lane exemptions for EV's as well as monetary incentives, such as tax exemptions or credits and registration fee reductions, emission test exemptions and parking incentives.

Arizona | California | Colorado | Connecticut | D.C. | Florida | Georgia | Hawaii | Illinois | Indiana | Iowa | Kansas | Louisiana | Maine | Massachusetts | Maryland | Michigan | Minnesota | Missouri | Montana | Nevada | New Jersey | New York | North Carolina | Oklahoma | Oregon | Pennsylvania | Rhode Island | South Carolina | Tennessee | Texas | Utah | Virginia | Washington | West Virginia | Wisconsin

STATE	HOV LANE EXEMPTION	MONETARY INCENTIVES	EMISSION TEST EXEMPTION	PARKING INCENTIVES	2011 PENDING INCENTIVES
Arizona	Yes	Electric Vehicle Equipment Tax Credit: Maximum of \$75 available to individuals for installation of EV charging outlets. Reduced Alternative Fuel Vehicle License Tax Alternative Fuel Vehicle Tax Exemption		Alternative Fuel Vehicle Parking Incentive: An individual may park an AFV in areas designated for carpool operators.	
California	Yes	Vehicle Purchase Incentives: City of Riverside residents are eligible for a rebate (worth up to \$2,000 for a new vehicle, \$1,000 for a used vehicle) toward the purchase of a qualified hybrid electric vehicle purchased in the City of Riverside.			
Colorado		Alternative Fuel Equipment Tax Credit: An income tax credit is available for a motor vehicle that uses or is converted to a hybrid electric vehicle.			
Connecticut				Alternative Fuel Vehicle and Hybrid Electric Vehicle Parking – New Haven, CT: New Haven provides free parking on all city streets for qualified AFVs and HEVs registered in New Haven, CT.	
D.C.		Alternative Fuel and Fuel-Efficient Vehicle Title Tax Exemption: Qualified vehicles are exempt from the excise tax imposed on an original certificate of title.			
Florida	Yes				
Georgia	Yes	Alternative Fuel Vehicle Tax Credit: An income tax credit is available for 10% of the cost (up to \$2,500 per vehicle) to purchase, lease or convert a qualified AFV. Zero Emission Vehicle Tax Credit: An income tax credit is available for 20% (up to \$5,000 per			263

			vehicle) of the cost to purchase or lease a new Zero Emission Vehicle.				
Hawaii			Electric Vehicle and Electric Vehicle Supply Equipment Rebate: Qualified residents may apply for rebates (20% of the vehicle purchase price, up to \$4,500 per vehicle) for the price of Electric Vehicles and Supply Equipment through the Hawaii EV Ready Rebate Program.				HI H 444 Exempts lessors from the rental motor vehicle surcharge tax when renting an electric vehicle. HI H 1016 Any electric vehicle displaying an electric vehicle license plate is exempt from the payment of parking fees.
Illinois	Yes		Alternative Fuel Vehicle and Alternative Fuel Rebates: The Illinois Alternate Fuels Rebate Program provides a rebate (80%, up to \$4,000) of the cost of purchasing an alternative fuel vehicle. Electric Vehicle Registration Fee Reduction: Electric vehicles can be registered at a discounted fee of no more than \$18 per year.				IL H 2867 Provides for tax exemptions for electric vehicles.
Indiana							IN S 304 Provides a sales and use tax exemption for the purchase or lease of a new qualified plug-in electric vehicle if the retail transaction occurs from July 1, 2011, through December 31, 2016
Iowa							IA D 1446 Provides a sales tax exemption for electric vehicle conversion kits.
Kansas							KS S 109 Provides tax credits for costs of installing electric charging stations.
Louisiana			Alternative Fuel Vehicle and Fueling Infrastructure Tax Credit: An income tax credit worth 50% of converting or purchasing an alternative fuel vehicle or constructing an alternative fueling station is available.				
Maine							ME S 319 Creates an income tax credit for the purchase of a qualified plug-in electric vehicle that is equal to the excise tax paid, up to \$1,000. The credit expires January 1, 2015.
Massachusetts							MA S 1490 Provides that an electric car and battery recharging station shall be exempt from sales tax.
Maryland	Yes		Electric Vehicle (EV) Tax Credit: A tax credit of up to \$2,000 is available against the excise tax imposed for the purchase of qualified plug-in electric vehicles.	Hybrid Electric Vehicle Exemption from Vehicle Testing Requirements			MD H 163 Allows a State income tax credit for tax years 2011, 2012, and 2013 only, for 20% of the cost of qualified electric vehicle recharging equipment placed in service by a taxpayer during a taxable

									year.
Michigan					Alternative Fuel Vehicle Emissions Inspection Exemption				
Minnesota									MN H 1365 Allows use of HOV lanes by electric vehicles.
Missouri					Alternative Fuel Vehicle Emission Inspection Exemption				
Montana				Alternative Fuel Vehicle Conversion Tax Credit: An income tax credit for up to 50% of the equipment and labor costs for converting vehicles to operate using alternative fuels is available.					
Nevada					Alternative Fuel Vehicle and Hybrid Electric Vehicle Emissions Inspection Exemption				
New Jersey		Yes			Zero Emissions Vehicle Tax Exemption				NJ S 987 Exempts residential electric vehicle charging systems from real property taxation. NJ A 9780 Exempts electric vehicle charging systems from real property taxation.
New York		Yes							NY A 4390 Exempts new electric vehicles, clean fuel vehicles and vehicles that meet the clean vehicle standards from the first year of registration fees. NY A 6592 Exempts electric vehicles from state sales and compensating use taxes.
North Carolina									NC S 194 Authorizes plug-in electric vehicles to operate in high occupancy vehicle lanes and exempts plug-in electric vehicles from the emissions inspection requirement.
Oklahoma				Alternative Fuel Vehicle Tax Credit: A one-time income tax credit for 50% of the cost of purchasing or converting an alternative fuel vehicle is available for tax years beginning before January 1, 2015. A tax credit for 10% (up to \$1,500) of the total vehicle cost is also available.					
Oregon				Alternative Fuel Vehicle and Fueling Infrastructure Tax Credit for Residents: Tax credits for 25% of the cost or \$750 (whichever is less) are available for the purchase or conversion of an alternative fuel vehicle and the purchase of alternative fuel infrastructure.	Pollution Control Equipment Exemption: Dedicated original equipment manufacturer natural gas and electric vehicles are not required to be equipped with a certified pollution control system.				
Pennsylvania									PA H 101 265

						Excludes the purchase price of electric vehicles, hybrid electric vehicles and zero emission vehicles from the sales and use tax. PA H 702 Exempts hybrid electric vehicles from the requirement for periodic inspection of vehicles.
Rhode Island			Alternative Fuel Vehicle Tax Exemption: The town of Warren, RI allows excise tax exemptions of up to \$100 for qualified AFVs registered in Warren.			
South Carolina			Alternative Fuel and Advanced Vehicle Tax Credit: 1) Residents who claim the federal vehicle tax credit are eligible for a state income tax credit equal to 20% of the federal credit.			
Tennessee	Yes					
Utah	Yes		Reduced Alternative Fuels Tax: The tax imposed on propane and electricity used to operate motor vehicles is 3/19 of the traditional motor fuels tax rate of \$0.245.			
Virginia	Yes					
Washington			Alternative Fuel Vehicle Tax Exemption: New passenger cars, light-duty trucks, and medium-duty passenger vehicles that are dedicated alternative fuel vehicles are exempt from the state motor vehicle sales and use taxes.	Alternative Fuel Vehicle and Hybrid Electric Vehicle Emissions Inspection Exemption		
West Virginia			Alternative Fuel Vehicle Tax Credit: An income tax credit for 35% of the purchase price or 50% of the vehicle conversion cost is available to convert or purchase an alternative fuel vehicle.			
Wisconsin			Alternative Fuel Tax Exemption: No tax is allowed on alternative fuels, or on the purchase, sale, handling, or consumption of alternative fuels.			

Sources:
National Conference of State Legislatures, 2011
Alternative Fuels Data Center, 2011

APPENDIX 10 INFRASTRUCTURE

ADENDUM TO CHAPTER 4:
INFRASTRUCTURE, DC FAST CHARGE INFRASTRUCTURE

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CONSIDERATIONS FOR DC FAST CHARGING

Direct Current charging, also referred to as “quick charging” or “fast charging” is a method of battery charging that uses high voltage direct current from the main power grid through a connection with an external charger. This type of fast charging allows most plug-in electric vehicles (PEVs) to re-charge up to 80% of their total battery capacity in less than 30 minutes.

Public accessibility to DC Fast Charging (DCFC) will be an important factor in the growing adoption of battery electric vehicles (BEVs) and will help drivers overcome issues with vehicle range. This document explores some of the key considerations for selecting and siting public DC Fast Charge stations.

SITE SELECTION

Selection of an installation location for a DCFC station is one of the most influential factors in determining overall station utilization.

Target Market

Prior to selecting a site location for DC fast charging equipment, it is important to define the intended purpose of the DCFC station(s). The intended use can be linked directly to the characteristics of the market it is trying to serve. DCFC stations can (1) connect cities that may otherwise be out of range for BEV travel, (2) provide convenient around-town charging, or (3) allow vehicle refueling at destination locations. Furthermore, DC charging stations may be made available for public access or restricted for private use at workplaces or for fleets. Defining the intended use scenario will help guide recommendations for host site selection.

Examples of the different charging station use scenarios are listed below.

	Intra-City	City-to-City	Destination
Public	Museum, Library, Grocery Store, College Campus	Rest-area, Road-side Business <i>(e.g. Restaurant)</i>	Zoo, Hotel, Vacation Locations
Workplace / Fleet	Transit Bus, Delivery Van, Taxi	Satellite Office or Warehouse	Corporate Headquarters

Table 1. DCFC deployment use scenarios.

Existing Infrastructure

The availability of existing charging infrastructure should be considered prior to site selection for deployment of new DCFC stations. An electric vehicle charging station locator can be found on the Department of Energy's Alternative Fuels Data Center website: <http://www.afdc.energy.gov>.

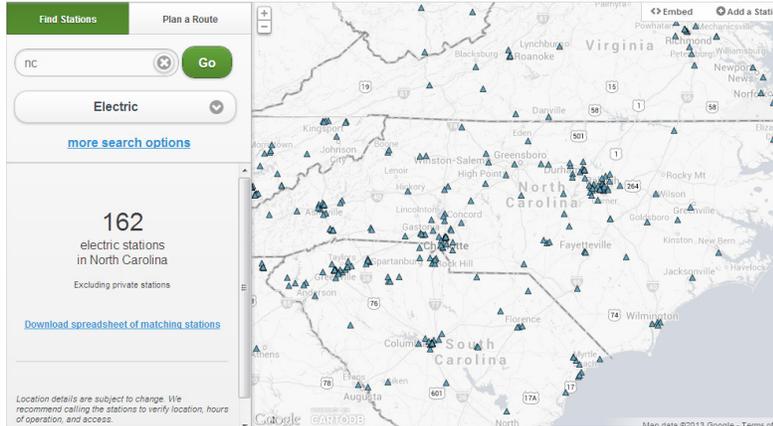


Figure 1. Map of publicly accessible EV charging stations.

Station owners should keep in mind that infrastructure gaps may be better accommodated by AC Level 1 and 2 charging in locations where the parking duration and power needs are compatible. For example, if you drive a BEV 40 miles and plan to park for more than 2 hours, Level 2 charging with a 6.6kW AC charger may suffice. Host sites should consider the appropriate charge level for the application to minimize equipment and installation costs.

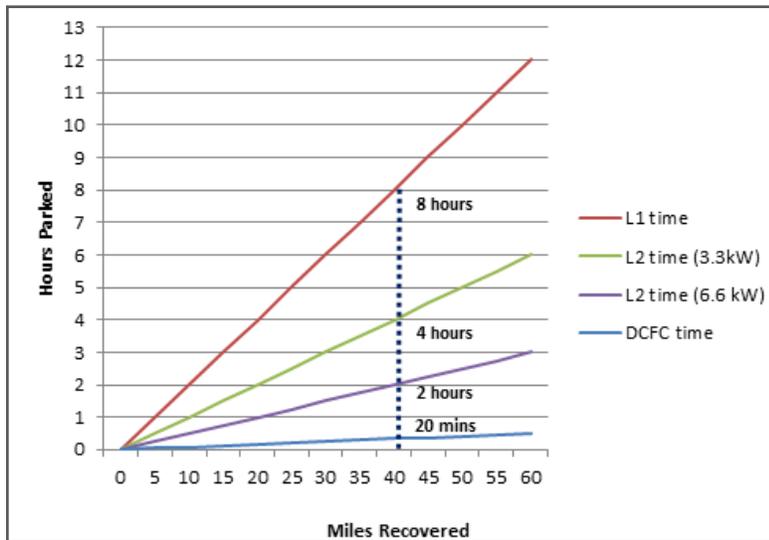


Figure 2. Charging time required for 40 electric vehicle miles.

Site Features

The following describe recommended qualifications for potential DCFC installation locations based on the physical characteristics and services offered at the property.

Location Relative to Urban High-Use Travel Corridors

Station locations should be within urban areas where PEV drivers are likely to want to go. Preferred sites

should be located within one quarter mile from high use travel corridors and sites with high travel density should be given priority. PEV owners will expect charging stations to be safe, convenient, reliable, easily identified, simple to use, and any fees collected for the service fairly priced.

Site Accessibility

Installation sites should be easily accessible via a route that can safely and conveniently accommodate PEVs of the types, sizes and weights that would be traveling to the facility, entering and leaving the facility, returning to the travel corridor and continuing in the original direction of travel.

Availability and Capacity of Electric Power Supply

Installation sites should have 208V or 480V 3-phase power available nearby, and be served by a transformer with adequate capacity for DC Fast Charger(s). The comparative ease of extending power to the preferred charging site, or the willingness of the host to invest in power supply upgrades may be a decisive factor in siting fast charge stations.

Site Layout

Sites should have physical geometry, including parking areas and ingress/egress points, that can safely and efficiently accommodate movements into and out of the site, onsite circulation, and parking by passenger vehicles and light duty trucks. ADA requirements for accessibility should also be addressed as appropriate. Consumers will expect consistency in their PEV charging experience from station to station, regardless of governmental jurisdiction.

Site Facilities

Sites should have restroom facilities available to the public at all times of operation. Preferred sites should have internet connectivity capabilities to facilitate communications between the EVSE, PEV, and to serve as the medium for the EVSE to be integrated with utility smart grid systems. Preferred services may include vending, snacks, fast food and/or full service restaurants, traveler information (tourist, hotels, and maps), or retail shopping.

Site Parking

Site should have adequate paved parking spaces available to render PEV charging services. Charge stations should be adequately lit, and in a location safe from traffic circulation and ingress/egress points.

Site Shelter

Preferred sites should provide immediate shelter from inclement weather while the driver addresses charging station operation and vehicle hook-up. The site should provide a location offering shelter from inclement weather for drivers to wait while their PEV is charging.

Signage

Station installations should comply with state and the local jurisdiction policies, procedures and project-related rules concerning signage, including signage for the PEV charging station, directional signage, project or funding source logos, etc.

OWNERSHIP AND OPERATING MODELS

A property owner has a variety of options for providing electric fueling services; including:

- Property and Equipment Ownership
- Lease of Property to EVSE Service Provider; or
- Lease of Equipment from EVSE Equipment Provider

Property and Equipment Ownership

Property owners may choose to purchase and install electric vehicle supply equipment (EVSE) at their own cost. Operation and maintenance of the EVSE can be performed by the site owner or alternatively, contracted to a third-party provider to perform this service. The site owner can access a fee for charging sessions and/or utilize the equipment surface area to advertise business. Point of sale card swipes can be installed for payment collection; but may require a service agreement or percentage of revenue. The equipment owner may also choose to join a network listing service to increase their customer base. Revenue generated from operation of the EVSE can help offset the initial installation, operation, and maintenance of the charging station.

Leasing your Property to an EVSE Service Provider

A property owner may choose to lease a site to an EVSE Service Provider, who would cover the total cost of installation, maintenance, and operation. The EVSE Service provider can collect fees for charging sessions and may provide the site owner with a percentage of total revenue generated. The EVSE service provider may negotiate to obtain access to the equipment surface area to advertise to offset the installation cost or leased space. This option allows a property owner to provide EVSE services with little to no out-of-pocket costs.

Leasing your Equipment from an EVSE Equipment Provider

A property owner may choose to lease charging equipment from an EVSE Equipment Provider. The property owner would be responsible for the installation and operating costs; however the equipment maintenance would be performed by the EVSE Equipment Provider. Fees for charging sessions may cover the cost associated with leasing the station and provide additional business. Leasing of the EVSE would reduce the initial investment requirements by the cost of the equipment.

Finance Options

There are many available monetary incentives created to encourage the use of alternative energy for transportation. Tax credits, grants, rebates and incentives are available on federal, state and local government levels, and both commercial and individual participants are permitted to take advantage of them. Investors or homeowners may also be eligible for rate discounts, as well as loans, from their local utility company to aid the expense of the electric vehicle charging equipment. Benefits may vary between states, local governments and local utility providers.

Return on Investment

EVSEs are not only an option for an alternative transportation method that reduces the dependence on gasoline and greenhouse gas emission; they are also an education and advertising site for environmental friendly structures and innovations. Additionally, where charging stations are combined with alternative energy generation, there may be a faster payback time because of the additional incentives and marketing value of the attraction or landmark.

STRATEGIC DEPLOYMENT AND GEOGRAPHICAL PLANNING

As noted previously, DCFC stations can be deployed to serve around-town travel needs, connect two or more cities, or provide an electric fueling opportunity at destination or tourist locations. Each deployment strategy provides unique advantages.

Urban Corridors

Usage corridors within urban settings typically serve local traffic needs with high utilization and limited distance. Charging opportunities along these routes can work to increase driver confidence and extend travel distances when needed.

City to City Connections

Charging opportunities focused on City to City connections available along primary roads and highways can enable frequent long distance travel and extend the daily commute options for battery electric vehicle drivers. With the current range of a majority of battery electric vehicles, a DCFC station could connect cities up to 75 miles apart.

Destination Locations

Destination charging can help attract visitors to a location that may otherwise be inaccessible with current electric vehicle ranges.

PROMOTING DC FAST CHARGING IN NORTH CAROLINA

The benefits of DCFC are numerous. Once deployed, drivers can increase their range confidence with knowledge that an easy and convenient charge is located along their travel corridor. New infrastructure can also help spur industry growth by creating new economic development opportunities and jobs. Currently over 60 North Carolina companies are playing a direct role in transportation electrification. Promotion of North Carolina DCFC deployments can help communicate availability to drivers and also provide economic benefits to the state as a whole.

National Efforts

DC Fast Charging is growing across the country, not just in North Carolina. One significant DCFC effort is the West Coast Electric Highway. This extensive network of electric vehicle DC fast charging stations runs along Interstate 5, and other major roadways in the Pacific Northwest. Located every 25 to 50 miles, these stations are placed at easy and convenient sites where a person could find themselves spending the 30 minutes of less required to recharge a full electric vehicle grabbing a cup of coffee or doing a little shopping. Locations are also all equipped with Level 2 charging equipment for Plug-In Hybrid Electric vehicles who are not equipped to utilize DC Fast Charging Technology.

The stations within the Electric Highway support other EV infrastructure investments. In fact, the Electric Highway is part of the overall public EV charging infrastructure which is provided through private companies, large employers, and other partners. The Electric Highway serves many major population areas including: Seattle, WA, Portland, OR, Eugene, OR, Salem, OR, Los Angeles, CA, and San Diego, CA.

Other similar investments include:

- The EV Project
 - This project is led by ECOtality North America and has fostered the deployment of nearly 15,000 Blink Charging stations (placed in residential, public and commercial spaces) in 16 cities and the District of Columbia.

Local Opportunities

North Carolina has the opportunity to invest in DC Fast Charge technology in a way which will embrace its strengths and allow it to successfully help Electric Vehicles continue to grow on the roadways. At the NC PEV Taskforce Fall Implementation Summit, held in Conover, North Carolina on October 24, 2013, one of the breakout sessions was focused on DC Fast Charging within the state. The attendees who elected for this breakout session were first given an overview of DC Fast Charging, and what the NC PEV Taskforce Infrastructure Working Group, has already done to ease its implementation throughout the state. After the overview, attendees were split into groups to discuss barriers and considerations, as well as opportunities, associated with the implementation of DC fast charging in North Carolina. Attendees worked in small groups to list what they felt were the most important barriers and considerations, as well as the most important opportunities, concerning this infrastructure and its placement.

OPPORTUNITIES

EV Corridors

North Carolina has several highly traveled corridors which connect many different metropolitan areas. By placing DC Fast Charging stations strategically along one or more of these corridors, similar to the West Coast Electric Highway, many similar benefits can be achieved including:

- Decreased Range Anxiety
- Increased EV Adoption
- Increased EV use for out-of-city trips
- Increased business for host locations of the physical DC Fast Charging Stations

Eco Tourism

With its beautiful mountains, and warm weathered sandy beaches, North Carolina has many different tourist destinations. One way to attract electric vehicle owners to your tourist destination would be to add a DC Fast charger. This can be applicable also to restaurants, hotels, and more. Those with Electric Vehicle Charging at their site could market themselves as an “Eco Tourism” destination. Places and best practices for this include:

- Parks
- Museums
- Restaurants (Free Valet for PEVs can be added)
- Hotels (Free Valet for PEVs can be added)
- Universities
- Sporting Areas
- Conference or Event Venues

Links to Renewable Energy

Environmental benefits are often a large motivator for Electric Vehicle adopters. Unlike standard ICE vehicles, who can only run on petroleum, Electric Vehicles have the luxury of running off whatever resources are utilized to create the electricity that they are charged with. This means that charging stations which are linked to renewable resources have the opportunity to allow their drivers to drive on harvested sunshine, wind power, or a number of other renewable options. Electric Vehicle Charging stations which are linked to renewable resources can be a large attractor as many drivers would choose the solar powered stations over one that runs off the mostly coal-generated electricity of our current electric grid.

EV Retailer Program

Another idea to help support DC Fast Charging, Electric Vehicles, and the businesses that host the charging stations is to have an EV Retailer Program. This program would provide recognition for retailers with DC Fast Chargers (and perhaps also Level 2 stations). They can be listed on a map of “EV Friendly Sites” within a city. This association could help them gain publicity, and attract the business of EV Drivers

who would often choose their venue over one without a charging location.

Incentive Policies

New technologies are often given a lot of governmental support. If North Carolina were able to adopt Governmental policies which were designed to provide incentives (monetary or not) to support DC Fast Charging infrastructure placement, many more businesses would be willing to invest in this technology. Although there are many benefits for businesses who host these charging stations, as can be seen in the sections above, a high upfront cost can be a deterrent for an otherwise interested host site. Monetary governmental incentives provided through local and state policy can make a big difference in increasing the adoption of a technology.

Challenges

Zoning and Planning

As Electric Vehicles are a new technology, current zoning and planning regulations specific to them can often not be found. The development of applicable codes and zoning regulations on a municipal level is needed. This will help standardize the installation process of charging infrastructure, as well as insure its correct placement.

Universal Charging Connectors

Currently there is not a universal DC Fast Charging connector. This is because Telsa, one of the major Electric Vehicle Manufacturers, had designed their vehicles and charging equipment prior to the mainstream designs seen on other vehicles (such as the Nissan LEAF). Because of this, there are many DC Fast Charging Stations deployed by Tesla which are inaccessible to drivers of other vehicles. Creating a standard for this could increase the use of all DC Fast Charging Stations by allowing drivers of many different vehicles access to all DC Fast Charging stations.

Codes and Enforcement of DC Systems

Currently most electrical work is conducted through AC power. This means that there are many necessary codes and enforcements available for this specific type of power, but not for DC systems. As DC Fast chargers obviously operate with the use of DC Power, it is vital that equivalent codes and enforcements be created for this in order to ease installation processes, and eliminate possible accidents and issues.

Infrastructure Maintenance

Those considering becoming a host site for a DC Fast Charger may be reluctant because they do not quite understand what will be required of them in terms of infrastructure maintenance. It is important that they be informed of the technologies required maintenance needs prior to installation. This could be done through a guidebook, or worksheet.

Interface with Electric Grid

One common fear concerning electric vehicles and their accompanying infrastructure is that they will overload the current electric grid. This is a possible barrier to the placement of DC Fast Chargers and should be explored further.

CONCLUSIONS AND RECOMMENDATIONS

Public accessibility to DC Fast Charging (DCFC) is an important factor in growing the adoption of battery electric vehicles. DCFC deployments across the state can help drivers overcome concerns of vehicle range and provide economic benefits to the state. While many challenges and barriers still exist for DCFC deployment, several installations are planned or are in process. Lessons learned from these first deployments will help guide the installations of the future and coordination of these deployments is essential to maximizing impact and making the most of opportunities that may exist with a state-wide network of infrastructure.