EVTC™
Electric Vehicle Transportation Center

Transportation Planning for Electric Vehicles and Associated Infrastructure

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EVTC Project 4 – Transportation Planning for Electric Vehicles and Associated Infrastructure

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The objective of Transportation Planning for Electric Vehicles and Associated Infrastructure is to identify and examine transportation infrastructure planning models and related policy issues associated with the deployment of Electric Vehicles (EVs) and to provide recommendations for transportation planning actions to enhance the accommodation of EVs and EVSE infrastructure. The work was conducted by David Block, Ali Raissi and Richard Raustad of the Florida Solar Energy Center.

Final Research Project Report

Transportation Planning for Electric Vehicles and Associated Infrastructure

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1.0 Abstract

Planning is the key to successful adoption and deployment of any new technology, and it is particularly important when that advancement involves a paradigm shift such as electrified transportation. At its core, electric transportation is largely a technology deployment. The vehicles and supporting infrastructure are unique to this mode of transportation; requiring new and specific planning and policies to support their deployment. This EVTC project brings together these planning elements and their role in the future U.S. transportation network. The project results are presented in five planning related subject areas: (1) Identification of 14 of the 22 EVTC program topics whose results have a direct role in the planning process; (2) Presentation of four case studies as examples of planning programs; (3) Proposed EV Transportation Planning Guidelines and Best Practices; (4) Impact of Volkswagen Settlement Beneficiary Mitigation Plan on the future of electrified transportation in the U.S., and (5) Hosting of two annual EV Transportation & Technology Summits.

2.0 Background

Transportation planning plays a fundamental role in a state, region, or community's vision for its future. The planning process includes a comprehensive consideration of possible strategies; collection of relevant data; analyses of data; the seeking of diverse viewpoints; the collaborative participation of relevant transportation-oriented agencies and organizations; and open and timely public involvement. The outputs are policy recommendations and roadmaps for the future actions.

This project identified and examined transportation infrastructure planning efforts and models and how they accommodate the deployment of Electric Vehicles (EVs). Note that in this publication the term electric vehicles (EVs) will refer to any vehicle that plugs into the electric grid for all or part of its power source. Therefore, the term EV will refer to battery-electric vehicles (BEV) such as the Nissan Leaf and plug-in hybrid electric vehicles (PHEVs) such as the Chevy Volt, or extended-range electric vehicles (EREVs).

Planning is a critical key to the successful adoption and deployment of any new transportation advancement. Electric transportation and the supporting infrastructure

are unique new modes of transportation that require new and specific planning and policies to support their deployment. Electric transportation has also seen significant advancement in the development of vehicle performance and safety standards. But, formal transportation planning, based on standards established by the US DOT, Federal Transit Administration, American Planning Association and others has seen minimal effort in the EV related area. A search of Transportation Research Board databases, a comprehensive literature search, and correspondence with the Federal Highway Administration has revealed one Federal Highway Administration publication in the EV area.[1] This FHA reference gives planning, policy, environmental, energy and sustainability comments and outlooks as of the published date of 2013.

Another US DOT effort was the conducting of a conference on transportation scenario planning held in Portland, OR in August 2016. Although planning was in the conference title, the output was largely dedicated to the subject of autonomous vehicles. The conference activities were as expected, but they did not produce standardized guidelines and best practices that could be utilized by professional transportation planners.

The other federal policy activity is the U.S. Department of Energy program guide that allows cities to easily conduct EV readiness for themselves. This project was an undertaking with DOE's Clean Cities Community Electric Vehicle Readiness Projects which concluded in 2013.[2] Details of the guidelines are presented in Case Study 1 below.

At the state level, California leads the way. In 2016, the Southern California Emerging Technologies: Mobile Innovations Plan was developed.[3] For this effort, SCAG analyzed a wide range of innovations that could potentially impact travel behavior and locational choices in the region over the next 25 years. The plan analyzed the widest possible range of technological advancements related to the transportation system. The result was a white paper covering mobility innovations which contained a matrix listing of approximately 50 individual technological innovations which were then grouped into 19 categories. The matrix was designed to evaluate the potential for each innovation to impact travel behavior and locational choices, and the potential for capturing these impacts in modeling processes. This program is presented as Case Study 2 below.

Another noteworthy state initiative was the Washington State Legislature who adopted a student transportation funding system. The system, known as the Student Transportation Allocation Reporting System (STARS), was implemented on September 1, 2012.[4] It provided an efficiency evaluation system for the school district transportation operations as an integral part of STARS. The legislative intent was to encourage school districts to operate their student transportation practices in a manner that makes efficient use of state resources through GIS data management. The regional transportation coordinators are required to conduct efficiency reviews of those districts with ratings less than 90 percent. This program is presented as Case Study 3 below.

The City of Orlando presents the fourth case study showing the type of planning and actions that a progressive city can accomplish.[5] The Orlando program is called Green

Works Orlando and it was established with the goal to transform Orlando into one of the most environmentally-friendly, economically and socially vibrant communities in the nation. Green Works Orlando represents the city's commitment to build partnerships and share resources that foster positive environmental changes.

3.0 Research Results

Electric vehicles (EVs) are becoming increasingly prevalent due to the widespread impetus to reduce energy consumption, curb greenhouse gas emissions, and develop a sustainable transportation system. Several states have enacted legislation to encourage the deployment of electric vehicles, and consumers, business and municipal agencies are increasingly turning to electric vehicle technology for its environmental and economic benefits. Emerging vehicle ownership models also recognize that electric, automated and connected vehicles are a viable solution to the short-term needs of next generation transportation users. However, many communities lack sufficient infrastructure to support next generation vehicles at home, at work, and elsewhere. Proactive planning is needed to support the convenient use of electric vehicles throughout the state and regional transportation systems.

The project results are presented in five planning related sections as follows:

1. Identification of the EVTC program topics whose results have a direct relevance to the planning process;
2. Presentation of four case studies as examples of planning efforts;
3. Proposed Transportation Planning Guidelines and Best Practices as applied to EVs;
4. Possible impact of a major financial program on the emerging electric vehicle transportation system due to the Volkswagen Settlement Beneficiary Mitigation Plan; and
5. Results from hosting of two annual EV Transportation & Technology Summits that were designed to provide opportunities to hear and discuss policies, planning and technologies that support EV deployment.

3.1 Identification EVTC Program Topics with Results That Have a Direct Application in the Planning Process

One of the most important outcomes of the Electric Vehicle Transportation Center (EVTC) program is the planning project task results for EVs and their role in the future U.S. transportation network. This EVTC project, "Transportation Planning for Electric Vehicles and Associated Infrastructure", brings the planning elements of the entire EVTC program findings together along with discussion of EV related planning efforts.

To begin the discussion on EVs and planning, the entire activities of the 22 projects of the EVTC program were first reviewed. Then those projects were identified for which the results can or may play a direct role in the planning process. Of the 22 EVTC

projects, 14 projects were directly related to the transportation planning process. These 14 EVTC projects and their relation to planning are briefly described below.

Project 1: **Implications of Electric Vehicle Penetration on State and Federal Highway Revenues** - Project evaluated the impact of the number of electric vehicles on federal and state highway revenue sources and state policy actions on electric vehicle tax options.

Project 2: **Identify and Analyze Policies that Impact the Acceleration of Electric Vehicle Adoption** –Project identified state and national regulatory policies on adoption and use of EVs and suggested new policies or regulations.

Project 3: **Electric Vehicle Charging Technologies Analysis and Standards** -- This project evaluated the technologies, codes and standards associated with Electric Vehicles (EVs), Electric Vehicle Service Equipment (EVSE) and the related infrastructure. Developed recommend practices to advance both vehicle and EVSE deployment. Data needed for charging station planning activities.

Project 5**: Prediction of Electric Vehicle Penetration** – Project evaluated yearly EV sales and growth in order to predict the number of future EVs in the US.

Project 6: **Electric Vehicle Life Cycle Cost Analysis** – Project compared total life cycle costs of battery electric vehicles, plug-in hybrid electric vehicles, hybrid electric vehicles (HEV) to vehicles with internal combustion engines. Analysis also included application of photovoltaics (PV) for charging and workplace charging options.

Project 7: **Assess the SunGuide® and STEWARD Databases** – Project used the Regional Integrated Transportation Information System (RITIS) as a database to provide vehicle usage figures for input data to an EV charging location simulation model for the Florida Turnpike. The database can be applied to other U.S. highway systems.

Project 8: **Battery Technologies for Mass Deployment of Electric Vehicles** – Project analyzed national driving trends and EV battery sizes that can be used to plan for optimum placement of EV charging stations.

Project 10: **Fuel Cell Vehicle Technologies and Infrastructure** – Project analyzed the current status of hydrogen fuel cell fueling stations and identified future planning options for fueling station placement and type of hydrogen production process to be used.

Project 13: **Optimal Charging Scheduler for Electric Vehicles on the Florida Turnpike** – Project developed a dynamic model, a queuing model and a decision making process to provide a systematic planning model for analyzing EVs and their impacts on the overall infrastructure of a highway system. The Florida Turnpike network was used as a test case.

Project 14: **Electric Vehicle Bus Systems** – Project analyzed data comparing electric buses to diesel buses using the StarMetro bus system of the city of Tallahassee, FL. Results included a mathematical model for optimal charging of the electric transit buses.

Project 16: **Electric Vehicle Fleet Implications and Analysis** – Project evaluated implementation, use and effectiveness of EVs in fleet operations for classes of vehicles from Class 1 motorcycles to Class 8 semi-trucks. Case studies were presented.

Project 18: **Socio-economic Implications of Large-scale Electric Vehicle Systems** – Project developed integrated sustainability assessment modeling programs for EVs in an electrified transportation sector. Modeling efforts included an integrated sustainability assessment model, a stochastic cost simulation model, an electricity mix sustainability model, a life cycle impact model and a comprehensive cradle-to-grave life cycle assessment.

Project 19**: Economic Impacts of Electric Vehicle Adoption** – Project evaluated EV adoption rates and usage that includes fossil fuel savings as applied to Hawaii or an island location.

Project 22: **Automated and Connected Vehicle Implications and Analysis** – Project evaluated future activities and policies of automated, autonomous and connected vehicles and how these vehicles will interact with EVs.

Although not directly related to transportation systems planning as discussed above, the future will likely see the need for transportation system planning to coordinate and combine its efforts with the planning for electrical power systems. In this regard, five EVTC projects are directly related to electric utility power systems and planning. These are:

Project 11**: Electric Vehicle Grid Experiments and Analysis –** Project provided experimental data from vehicle-to-grid laboratory simulations for use in electrified transportation system and its interaction with a smart electrical grid network.

Project 12**: Electric Vehicle Interaction at the Electrical Circuit Level –**Project investigated the effect of electric vehicle charging and discharging on the circuit level utility distribution grid for residential applications.

Project 17**: Electric Vehicle Energy Impacts –**Project used two utility models to evaluate the impacts of electric vehicles and renewable power generation on power production for the Island of Oahu. Results estimated the reduction of petroleum imports to Hawaii.

Project 20**: Techno-Economic Analyses of Large-Scale Electric Vehicle Systems** – Project developed computer models to evaluate the techno-economic implications of a large-scale electrified transportation sector and its interaction with a smart electrical grid network.

Project 21**: Effect of Electric Vehicles on Power System Expansion and Operation –**Project examined the impacts of electric vehicles on electric power system design and operation by using an existing Hawaii developed utility model.

For detailed descriptions of the any of the above projects, see http://evtc.fsec.ucf.edu/research/index.html.

3.2 Planning Case Studies

In this section, four case studies illustrate specific examples of EV planning.

Case Study 1 -- **U.S. Department of Energy Clean Cities Community Electric Vehicle Readiness Project**[2]

U.S. Department of Energy has developed a protocol that allows a U.S. city to conduct an EV readiness guide. The guide will assess the readiness of the region for EVs and provides suggestions as to regional actions and/or policies. This program awarded nearly $400 million to fund hundreds of projects in 10 regions across the U.S. The 10 participating regions were: Southeast Region, Atlanta, GA; Southeastern Pennsylvania's Region, Philadelphia, PA; Texas River Cities, Austin, TX; North Carolina Plug-In Electric Vehicle (PEV) Taskforce, Charlotte, NC; Northeast, New York State Energy Research and Development Authority , Albany, NY; Mission Electric, New York City, NY; Drive Electric Florida, Hollywood, FL; EVs in Paradise, Honolulu, HI; Drive Electric Ohio, Columbus, OH and Project Fever Fostering Electric Vehicle Readiness, Greenwood Village, CO. These projects were all completed in 2013. Each of the regional projects completed a final report that can be viewed at: https://cleancities.energy.gov/partnerships/

Case Study 2 -- **Southern California Emerging Technologies: Mobile Innovations Plan**[3]

As expected, California has been the most active in planning efforts that involve EVs. The document entitled “Emerging Technologies: Mobile Innovations,” has been developed by the Southern California Association of Governments (SCAG). For this effort, SCAG analyzed a wide range of innovations that could potentially impact travel behavior and locational choices in the region over the next 25 years. This case study describes the methodology used by SCAG to identify possible improvements in regional mobility that will most likely come from how technology is used, rather than from any individual technological development. For this reason, the Plan uses the term “innovations” instead of “technology.”

The specific objectives of the plan were to:

- Describe policy recommendations for maximizing the environmental and social benefits of these innovations;
- Document the methodology used for analyzing specific mobility innovations;

- Summarize available research on a wide range of individual technological innovations related to transportation;
- Review these innovations for relevance to SCAG planning and modeling practices; and
- Describe selected innovations or packages of innovations that were recommended.

The plan was developed by the SCAG planning and modeling staff working with an internal SCAG working group. The working group analyzed the widest possible range of technological advancements related to the transportation system. The result of this effort was a white paper covering mobility innovations which contained a matrix listing of approximately 50 individual technological innovations which were then grouped into 19 categories. The matrix was designed to evaluate the potential for each innovation to impact travel behavior and locational choice, and the potential for capturing these impacts in SCAG's modeling processes.

The working group prepared a catalog of applications and innovations or packages of innovations that could have an impact on the transportation system. The working group then refined this list to innovations or applications that could be incorporated into the scenarios developed to analyze the 2016 plan based on their impact. The innovations that were selected for further review were those which could have a profound impact in a limited geographic area or a more diffuse impact over a wider geographic area within the region. Of the eleven innovations, SCAG identified six innovations that should be supported through investment plans and supportive policies. Two additional innovations were reviewed at a qualitative level, giving the following list of three innovations with corresponding sub-topics:

- Innovations analyzed for potential greenhouse gas emissions reductions that included: Alternative Fuel Vehicles (Specifically Zero Emissions Vehicles), Neighborhood Electric Vehicles (NEVs) and Shared Mobility Services including car sharing (roundtrip and one-way) and ride sourcing (also known as Transportation Network Companies);
- Innovations supported through policy language and further research such as Connected / Automated Vehicles and Open Transit Data;
- Innovations analyzed for greenhouse gas emissions reductions such as Bike Sharing, Intelligent Transportation Systems (ITS) Roadway and Telecommuting and Work-at-home.

To analyze these innovations, SCAG translated planning assumptions into analysis parameters. Based on the available research, SCAG used conservative time frames for deployment of the innovations identified for further analysis. Each of the innovations listed above were then subjected to analysis methodology with the results being policy recommendations for each item.

Case Study 3 --**Student Transportation Allocation Reporting System (STARS) State of Washington**[4]

This case study describes the development and adaptation of an efficiency evaluation system for school district transportation operations in the state of Washington as part of the student transportation funding system implemented on September 1, 2013. The rating system was called Student Transportation Allocation Reporting System (STARS) and was used for the distribution of operations funding for school district transportation and for providing an evaluation of relative efficiency.

STARS funding uses a regression analysis to input individual school district characteristics and to determine an expected cost of operations. STARS Efficiency ratings are calculated using a different statistical system (Data Envelopment Analysis).

The efficiency of a school district's transportation operation is determined by several interrelated factors, such as a district's policy on minimum walking distance between a student's home and a school bus stop; and school start and end times, which may be different for schools within a district. Other variations among school districts (for example, student enrollment or geographic characteristics) can complicate the identification of the specific reasons for a particular district's efficiency rating.

The statistical system used to create the efficiency ratings is called the Target Resource Model (TRM) and was developed by Management Partnership Services (MPS), the consultant hired by the Office of Financial Management to provide options for the student transportation funding methodology through the use of Geographical Information System (GIS) data analysis. For districts rated as less than 100 percent efficient, TRM creates a statistical target district from actual school districts across the state that have environmental features, size characteristics and workload requirements that are the same or more challenging and compares the district's total transportation costs and the number of buses used with this target. The target district establishes the expected resource requirements (expenditures and number of buses) that would be needed to achieve a 100 percent efficiency score.

A technical description of the Target Resource Model or Target Cost Management Tool is available on OSPIs Student Transportation website under Reports/Studies at: http://www.k12.wa.us/Transportation/publications.aspx.

Case Study 4 – **City of Orlando, FL**[5]

The City of Orlando presents an outstanding case study of the type of planning and actions that a progressive city can accomplish. Under the leadership of Orlando Mayor Buddy Dyer, the Green Works Orlando program was established with the goal to transform Orlando into one of the most environmentally-friendly, economically and socially vibrant communities in the nation. Green Works Orlando represents the city's commitment to build partnerships and share resources that foster positive environmental changes.

In 2013, Mayor Dyer appointed a 20-member task force to make recommendations for a Community Action Plan to make Orlando one of the most environmentally-friendly cities in the Southeast. Chaired by Former Orange County Mayor Richard Crotty, the task force considered input from 14 round table meetings with subject-matter experts on seven topics related to sustainability. In addition, the group received public comment from community meetings and an interactive online forum. The resulting plan was comprised of six areas – energy and green buildings, local food systems, solid waste, livability, transportation and water. The plan was then implemented and has experienced great successes in all areas.

In the transportation area, the goal was to find ways to make it easier for residents to walk, bike, car-pool, ride transit and use alternative fuel vehicles. The City is currently pursuing a series of improvements to enable residents to reduce reliance on private automobiles and invest in infrastructure to encourage more sustainable choices like bike racks, sidewalks and electric vehicle charging stations. The plan is guided by the following goals and targets:

Table 1. Green Works Orlando Ride Share Transportation Planning Goals

Metrics	2010 (baseline)	2018 (targets)	2040 (goals)
Percent of Daily Trips Made by Carpool, Transit, Bicycle, or Walking	20% of all trips	30% of all trips	>50% of all trips Increase the use of electric vehicles/alternative fuel vehicles throughout the City. Attain a "good" rating on the Air Quality Index (AQI) 365 days/year
Miles of "Complete Streets" Across the City	18.8 miles	20% increase (23 miles)	Double the miles of "complete streets" (38 miles)
Eliminate Pedestrian and Bike Fatalities		50% reduction	100% reduction

The plan also sets the goal of leading by examples. In transportation the first example is a fleet of electric vehicles. The City of Orlando's boasts 1,689 advanced fuel vehicles currently in its fleet and plans to grow this number to a total of 2,389 by 2030. The transportation plan includes commercial CNG garbage trucks, residential hydraulic hybrid CNG garbage trucks, electric and hybrid city fleet vehicles, plug-in hybrid city trucks, wireless charging and traffic signal and street light conversion to LED throughout the city.[6]

Figure 1. City of Orlando, FL EV Charging Station

Transitioning to a green city fleet

Orlando plans to become the electric vehicle (EV) leader in the Southeast region by increasing the number of electric vehicle charging stations with Get Ready Central Florida**,** an interagency consortium promoting electric vehicles. Orlando was selected as a "ChargePoint America" community, facilitating the installation of 200 Coulomb electric vehicle-charging stations.

Another transportation initiative is providing free trips with its LYMMO Bus Rapid Transit (BRT) expansion**.** LYMMO is a free Bus Rapid Transit (BRT) service that is a "rail like" service using rubber tired vehicles. Buses operate in their own right of way providing a non-congested route downtown and to major destinations. When this service was created more than 10 years ago, Orlando was one of the first cities to use a BRT system. Now, two expansions are underway expanding into the Creative Village, Parramore and Thornton Park so that more people can have access.

3.3 Transportation Planning Guidelines and Best Practices

Recognizing the need for formalized transportation planning in support of EV deployment, EVTC researchers partnered with colleagues at the Center for Urban Transportation Research (CUTR), a UTC located at the University of South Florida.[7] The information provided in this section is based on this partnership. These guidelines and best practices are presented to assist metropolitan and regional planning organizations to evaluate their ongoing efforts and goals and are as follows:

- Federal policies and standards supporting EV deployment (e.g., CAFE, Clean Air Act, Energy Policy Act, Executive Order 13693, FAST Act, Section 1413, Alt Fuel Corridor Designation, etc.)
- State and regional agency roles in accommodating EV needs
- Benefits of EVs to air quality, energy consumption, safety, GHG emissions, and noise
- Deployment of electric vehicle charging infrastructure (also known as electric vehicle service equipment, or EVSE)
- Charging station siting and design
- Existing and emerging technologies and corridor implications (e.g. SMART roadways, energy generating roads, plug-ins: self-charging stations for autonomous vehicles)
- Transportation funding implications
- Electrical grid implications
- Provisions for electric vehicle parking
- Zoning, building codes, and permitting
- Signage
- Outreach, education, and training

The goal of a plan is to identify barriers to electric vehicle readiness, to use national best practices for supporting electric vehicles through appropriate state, regional or local level planning initiatives, to develop an economic analysis methodology that can be used in the planning process and to examine the capital, operating and maintenance cost implications relative to meeting projected demand for EVs.

3.4 Volkswagen Settlement Beneficiary Mitigation Plan[8]

Although not directly a part of EVTC project planning deliverables, a recent development with national impact is the Volkswagen AG's (VW) historic settlement with United States Environmental Protection Agency (U.S. EPA). This event and the manner in which it will play out can potentially have a significant impact on the emerging electric vehicle transportation economy. In June, 2016, the U.S. Department of Justice issued a partial consent decree settling claims by the U.S. EPA and the Federal Trade Commission against German automaker VW. Volkswagen has agreed to spend $14.7 **billion** to settle allegations that installed software in its 2.0 liter diesel engine vehicles was intentionally made to disable emission controls under normal use and to turn on emission controls only when the vehicle was being tested. This "defeat device" resulted in the release of thousands of tons of NO_X emissions in excess of regulated limits.

One of the requirements of the VW-EPA settlement is that the auto maker must create, among others, a National Zero Emission Vehicle (ZEV) Investment Plan and spend $2 billion on ZEV infrastructure and programs aimed at educating the general public on the benefits of zero emission vehicles. The mechanism for disbursing the funds to the States, Puerto Rico, the District of Columbia and tribes is as follows. First, an environmental mitigation trust is established (known as the "trust effective date"). Next, each state and territory may elect to become a beneficiary by filing a "Certification for

Beneficiary Status under Environmental Mitigation Trust Agreement" (known as the "Certification Form") with the Trustee. Prior to submitting the Certification Form, the Governor's office must appoint a lead agency and ensure the state's compliance with all requirements outlined in the form. After a state has filed its certification form, the trustee will approve or deny beneficiary status. If approved, the state is to submit a "beneficiary mitigation plan" for public comments.

The primary goal of the environmental mitigation trust is to reduce NO_X emissions. Prime movers (including diesel and gasoline vehicles) are currently the largest source of NO_X emissions. Reducing the use of petroleum-based fuels in transportation particularly in heavy duty vehicles is the key to reducing NO_X emissions. Under the terms of the VW-EPA settlement, beneficiaries are also allowed to consider how environmental mitigation trust funds could help achieve additional goals related to economic development, health, fuel security, greenhouse gas emissions, energy, renewable portfolio standards, and benefits to vulnerable populations.

Among alternative fuel options eligible under the terms of settlement, electric vehicle (EV) support is highly encouraged especially in conjunction with the electric grid as one integrated system. The flexibility of EV charging creates the opportunity to absorb excess power, such as that generated intermittently from renewables like wind and solar energy. Technologies such as electric school and transit buses fit very well into such renewables-based power generation scheme. Buses can charge using solar power during the day between services and if necessary, they can be charged again at night, when electricity use is at its lowest. EVs, as a part of a more dynamic, smarter grid, also offer the opportunity for energy storage and by feeding power back to the grid during peak demand periods.

3.5 EV Transportation & Technology Summits

EVTC researchers evaluated the opportunities for EV stakeholders to gather and discuss planning advancements and then determined that these opportunities were very limited, particularly in the eastern half of the U.S. Thus, EVTC staff organized a conference to provide the opportunity to present and discuss updates to the policies, planning and technologies that support EV deployment. The EV Transportation & Technology Summit was created for this purpose and was hosted in 2015 and 2016 at the University of Central Florida's, Florida Solar Energy Center, on UCF's Cocoa, FL campus.

The EVTC Summits focused on updates to the technologies, planning and policies needed to accelerate the deployment of electric vehicle transportation. Topics included automated and connected vehicles, EVs, transportation policy and planning, fleet management, workplace charging and the life-cycle assessment of EV vehicles. Panel discussions, technical workshops, a student poster session and vehicle displays were parts of the Summits.

The total audience for the Summits was 190 individuals that included:

- Transportation planners (MPOs, TPOs and DOTs)
- Planning, design and policy analysis consulting firms
- Power service providers
- Governmental and private sustainability managers
- Large-scale employers
- Automobile manufactures, dealers and associations
- Fleet managers

A total of 36 speakers participated in the 2015 and 2016 Summits, presenting topics including: technology and standards, vehicle-to-grid applications, fleet management, product offerings, public and policy awareness, regional infrastructure, transportation planning for EVs, electric transit, wireless and workplace charging, life-cycle assessment, transportation and mobility innovation, and the perspectives of power service providers and OEMS. Both of the conference agendas and both conference presentations are posted at the Summit website, http://www.evsummit.org. For the 2016 Summit there were 14 sponsors as follows. Overall, the audience was very pleased and had positive evaluations.

4.0 Conclusions

This project identified and examined transportation infrastructure planning efforts and models and how they accommodate the deployment of Electric Vehicles (EVs). The results identified 14 of the 22 EVTC project topics that provided results that have a direct role in the transportation planning process and five EVTC projects that were directly related to utility power systems and planning. Although the future is difficult to predict, the authors see a critical need for transportation system planning to be closely coordinated with the planning efforts for electrical power systems. This report also provides four case studies as examples of planning programs; a suggested EV Transportation Planning Guidelines and Best Practices list; information on the $14.7 billion Volkswagen Settlement Beneficiary Mitigation Plan and results from the two annual EV Transportation & Technology Summits held at the Florida Solar Energy Center.

5.0 Impacts/Benefits

Transportation planning is a key element in the adoption of EVs and other alternative fuel vehicles. Providing guidance for local governments and planning organizations on the integration of these vehicles will provide considerable social, economic and environmental benefits.

6.0 References

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