Title: I/UCRC: Center for Electric Vehicles - Transportation and Electricity Convergence (EV-TEC) at Kansas State University

Introduction

Kansas State University has strong research programs related to electric power, renewable energy, and sustainability. This proposal is part of an effort to develop and integrate the science, engineering, and education associated with sustainable energy, the electrification of transportation, charge stations, and electric power systems. Kansas State University has a strong interest in the development of solar powered charge stations for plug-in electric vehicles (PEVs). The Industry/University Cooperative Research Centers Program (I/UCRC program) is intended to be a cooperative effort in which university faculty and students work cooperatively with industrial partners. This includes cooperative efforts to develop research projects that are of mutual interest to the industrial partners, NSF, and the participating universities. The University of Texas at Austin and Texas A&M University began receiving NSF support for the EV-TEC I/UCRC in 2010, which conducts research on the role of electric vehicles in the convergence of transportation and electric power infrastructures. Kansas State University wishes to become a partner university in this EV-TEC I/UCRC. The goal is to develop a strong I/UCRC that has a life of 10-15 or more years and serves societal needs effectively.

Research Project Topics

The research program at the EV-TEC includes the following topics:

1. Impact of PEVs on Smart Grid Reliability, Resilience, Safety, and Efficiency
2. Dynamically Configurable & Dispersed Energy Storage: Effects on Power Markets
3. Use of PEVs for Interfacing Renewable Energy Sources & Energy Security
4. Vehicle Purchase, Driver Behavior & Power Pricing: The Spatiotemporal Impacts
5. Information Systems: Interface Design and Systems Management
6. Air Quality Impacts & Management: Policy and Practice
7. Opportunities for Government Incentives & Public Infrastructure to Support PEV Utilization
8. Regulation of New & Existing Markets
9. Congestion Management and Charge Station Siting

Many faculty at Kansas State University have research interests related to the above topics. Research and development related to solar powered charge stations for PEVs fits well with the nine research topics developed for the EV-TEC. One of the early goals at K-State is to develop a solar powered charge station field site for research associated with the development of parking lots with solar photovoltaic systems that provide shade for vehicles and electrical power for charging PEVs at the field site. The site would be used for research, development, demonstration, and education.

In conducting research with industrial funding, it is important to listen to inputs from industrial partners and potential consortium members. Information on research needs is invited and encouraged. The scope of the research effort is related to work that is needed to develop an effective and efficient

infrastructure for PEVs that functions well with a modern smart electric grid. Some potential research topics related to 1-9 above include

1. Research related to power quality, efficiency, dynamics, resilience and stability associated with solar powered charge stations. The field site will be used to investigate dynamics, power electronics and voltage control.
2. Infrastructure research on charge stations for PEVs, including market penetration, business models, locations, customer preferences, security, and safety.
3. Charge station smart grid demand management research to address available power, efficiency, and business models associated with PEV charging with limited and peak power considerations.
4. Investigation of implementation aspects of the concept of using parking lots with smart grid control of power flow for spinning reserve management. Research on smart grid management of major events such as PEV charge stations in shopping center parking lots on the day after Thanksgiving when the lots are full.
5. Transmission management and smart grid research related to parking lots full of charge stations including vacant business-located parking lots with solar powered charge stations on weekends, cloudy days, major events, and evening events.
6. The solar powered charge station field site may be used to investigate the long term performance, reliability, power quality, efficiency, resilience, and maintenance needs of different products that are available for commercial use.
7. Power electronics research will be conducted to develop improved products such as inverters and control systems for smart grid and charge station applications.
8. Research on power storage may be conducted as part of an investigation of micro-grid function and power quality for solar powered charge stations in micro-grids.
9. Research on the effects of growing infrastructure capacity and visibility on PEV purchase decisions and public perceptions of PEVs.

Faculty for the I/UCRC

The research effort would be open to all faculty who are interested in the research topics, including faculty in engineering, economics, computer science, and psychology. Faculty who have expressed interest includes Michael W. Babcock, Terrie Boguski, Gary L. Brase, Larry E. Erickson, Wendy Griswold, Keith L. Hohn, Kimberly W. Kramer, Blase Leven, Behrooz Mirafzal, Bala Natarajan, Anil Pahwa, Noel Schulz, and Robert Stokes.

Vision

There are several social, environmental, and economic reasons to develop solar powered charge stations. No new land is needed to add solar panels and charge stations to parking lots. The operating cost of vehicles is significantly less with electrical energy, and this advantage is expected to become even better in the future. Since the electrical power range of plug-in hybrid vehicles is small, there are economic benefits of charging at home and at work. Petroleum supplies are finite, and they will last longer and be less expensive if solar/electrical energy is used extensively for transportation. Solar powered vehicles have the potential to reduce air emissions associated with transportation and improve air quality. The transient power production associated with solar panels fits well with the charging that

is needed during the work day. With solar powered charge stations, the power generation is close to where it is used, which reduces transmission costs. There are many employment opportunities associated with the manufacture, installation, operation, and maintenance of solar powered charge stations. The solar panels shade vehicles, reduce heat island impacts, and provide protection from rain, snow, and ice. The future cost of climate change will be reduced by using solar powered charge stations.

Industrial Partnerships

Kansas State University is looking for industrial partners for this proposed EV-TEC I/UCRC. See the program solicitation NSF 12-516 at nsf.gov for more information on the I/UCRC program. The goal is to find 4 or more industrial partners that will provide $40,000 annually to participate in a K-State EV-TEC research program that would have $160,000 annually and 4 partners. With K-State added to the current center, there will be more than $480,000/yr of research being conducted. All of the research results are made available to all of the industrial participants. There are two meetings annually to select projects and report research results. Each full partner has one vote at the meeting where proposals are reviewed and ranked to select projects. There are opportunities to participate at the $20,000/yr level as well but with no voting rights.

Contact Information

Please contact Larry E. Erickson, Anil Pahwa, or Robert Stokes for more information.

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