

Building a testbed for EV wireless charging solutions – experiences and thoughts for standardization aspects

PRESENTATION

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Wireless charging as potential disruptive technology in transportation electrification

TRANSPORTATION ELECTRIFICATION

Vehicle Innovations



All-electric



Plug-In Hybrid



Fuel-cell

Component Innovations



Infrastructure Innovations



Wireless charging



Smart grid



Hydrogen from renewables

Wireless charging needs to be looked at in context with intelligent transportation

INTELLIGENT TRANSPORTATION

Vehicle Innovations



Car-2-Car

Automated driving

Car-2-Infrastructure

Car-2-Cloud

Car-2-Device

Car-2-Person

Infrastructure Innovations



Wireless Communication

Internet of Things

Cybersecurity

Quantum Computing

Wireless charging can support the adoption of new business models

MOBILITY SERVICES



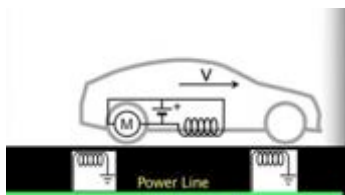
Personal Rapid Transit



Automated Parking



Automated Refueling



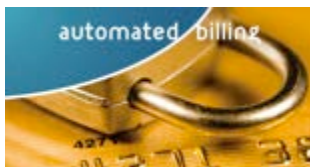
In-motion Charging



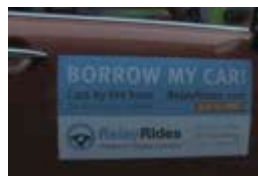
Automated Drive-Through



Digital Coupons



Automated Billing



Car sharing



Car & driver monitoring

US DOE is investing in the development of EV wireless power transfer technologies

Overview

Timeline

- **Start – Oct. 2012**
- **Finish – Sept. 2015**

Budget

- **Total project funding \$11.3M**
 - DOE share – 72.9%
 - Cost share – 27.1%

DE-FOA-000667 Wireless Charging for Electric Vehicles

Barriers

- Diverse, early stage, products beginning to proliferate in marketplace due to lack of standardization
- Uncertainty in product offerings regarding control method (grid-side, vehicle-side, or both), coupling coil field pattern (polarized or not), and data communications
- Safety protocol: Is primary pad isolation needed?

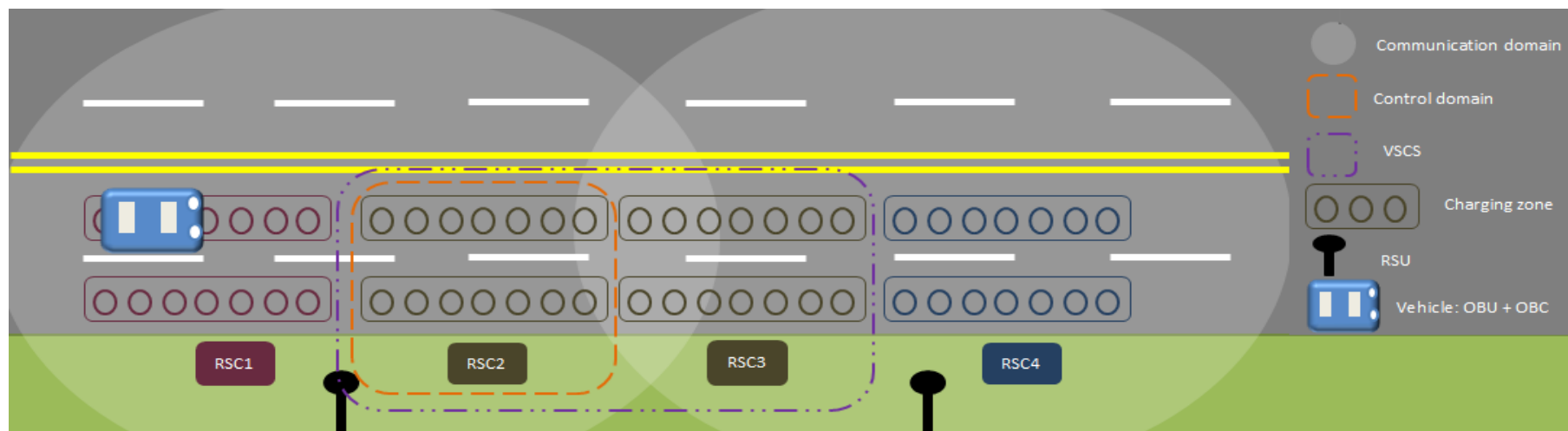
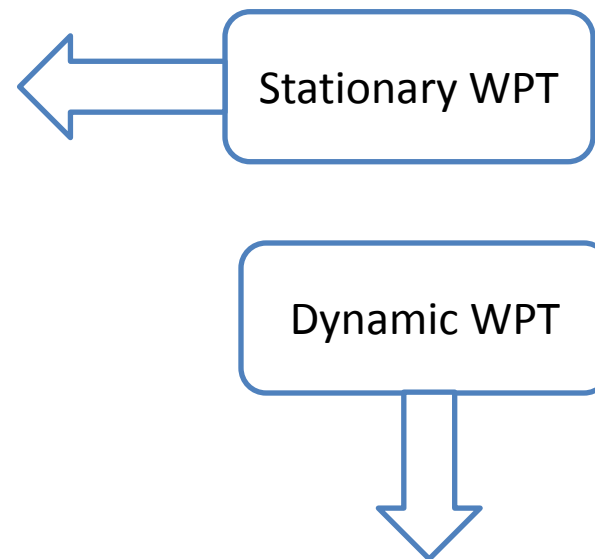
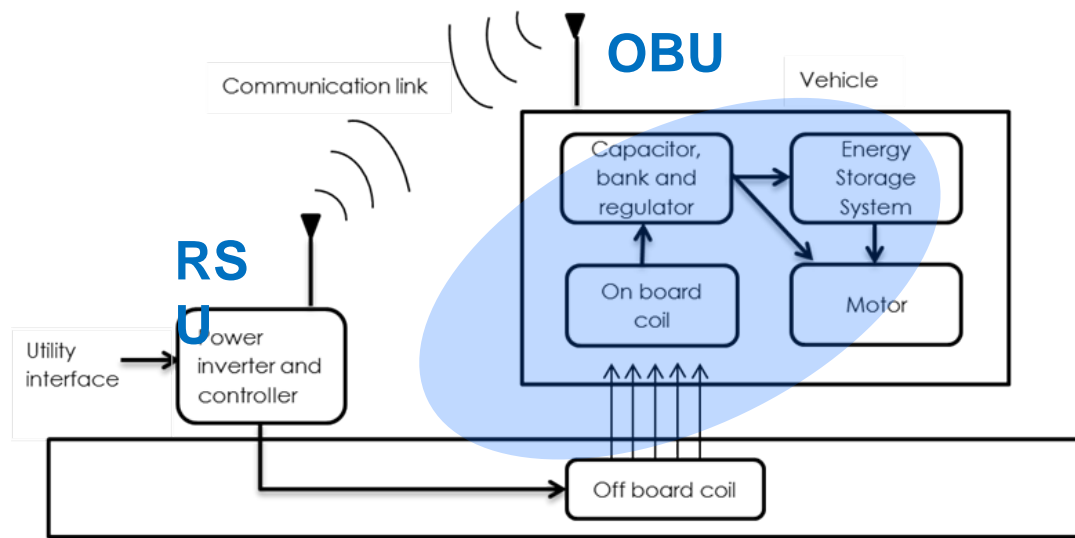
Targets Addressed

- **Match J1772 conductive charging efficiency of >85%**

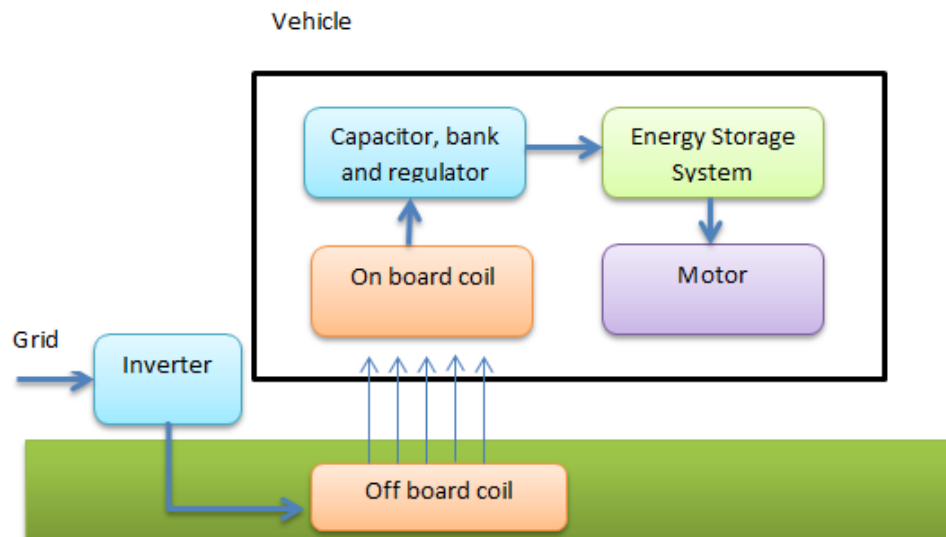
Partners/Collaborators

- **ORNL Team Members:** David Smith, PT Jones, Paul Chambon, Omer Onar, Cliff White, Chester Coomer, Steven Campbell, Lixin Tang, Puqi Ning,
- **Commercialization Partner:** Evatran Plugless Power
- **Communications Partner:** Clemson-ICAR
- **Automotive OEM:** GM and Toyota
- **Supporting partners:** Duke Energy, International Rectifier

Stationary vs. dynamic WPT



Standardization aspects EVWPT



Proprietary:

Coil design, power electronics, inverter system design

To be standardized:

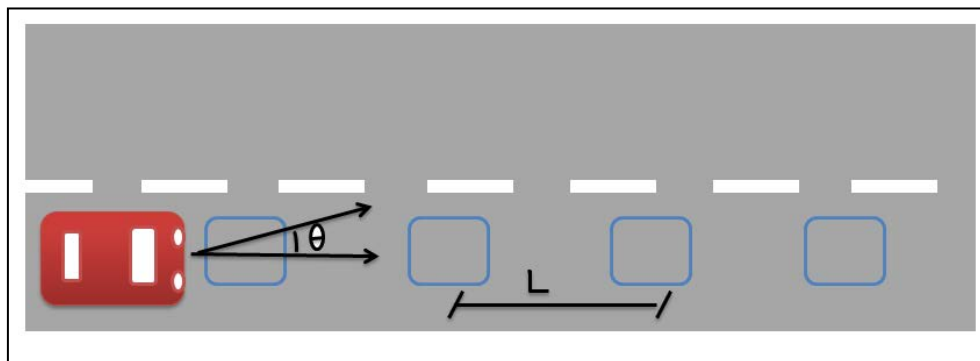
communication standards, system performance, system safety, operating frequency, mounting locations, alignment techniques

IEEE Standards Organization has initiated a Electrical Vehicle Wireless Power Transfer Industry Connections Activity.

Motivation and goal:

This IEEE Standards Association Industry Connection Activity is related to pre-standardization efforts in the domain of Electric Vehicle Wireless Power Transfer with a particular focus on **dynamic wireless charging** as these efforts address the range limitation of electric vehicles as well as the cost aspect of the vehicle energy storage and complement the current standardization activities of the SAE (J2954) which is centered on stationary charging.

Challenges of dynamic wireless power transfer



Synchronization of energizing coils, timing of power transfer

Acceptable power levels

Vehicle alignment

Allowable speed profiles

Multiple vehicles on charging lane

Clemson University International Center for Automotive Research (CU-ICAR)

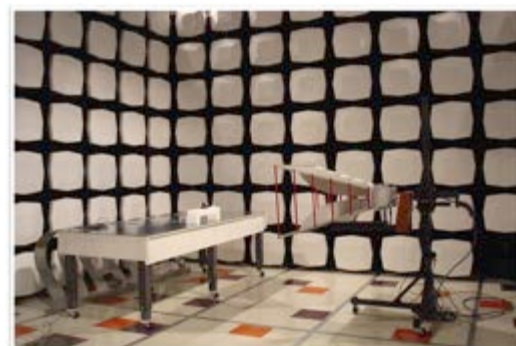


South Carolina's economic development strategy is driven by a cluster approach to improve competitiveness (inspired by Michael Porter from HBS).

The foundations of CUICAR (Clemson University International Center for Automotive Research, www.cuicar.com) have been created in 2003 (ground breaking) to develop an Automotive cluster, the first campus facility was built in 2005 (BMW ITRC).

CUICAR is the largest dedicated research campus focused on automotive engineering research in the South East. So far more than 250 million USD have been invested in the public-private partnership.

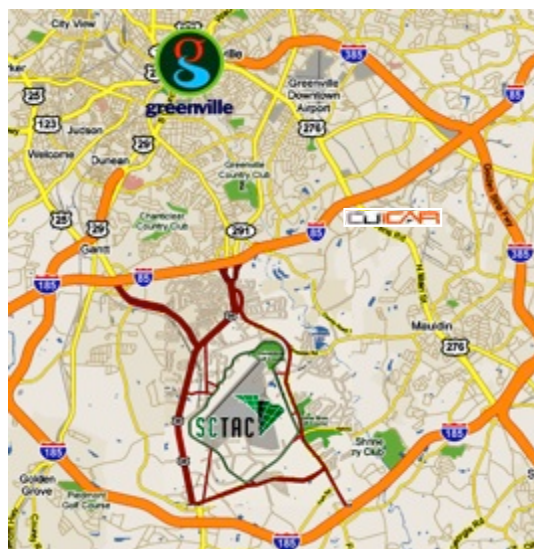
IEEE CU-ICAR campus development



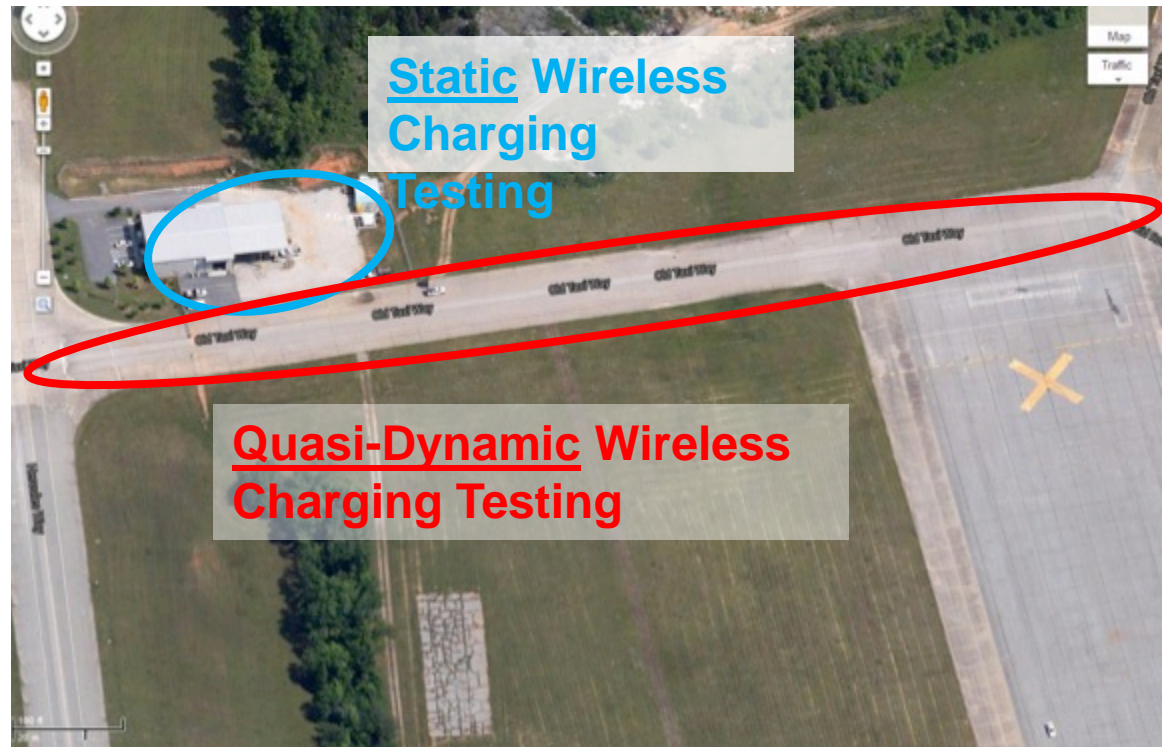
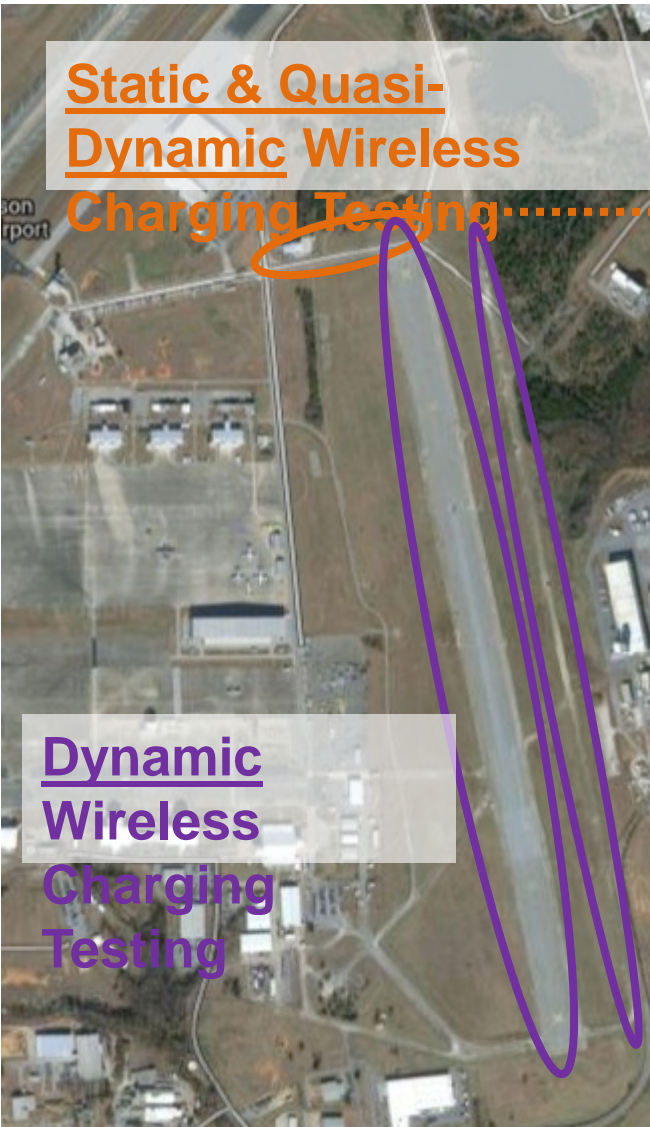
Redevelopment of an airport site to support vehicle and infrastructure testing

An airport-based business park with 2'600 acres and more than 80 companies teamed up with CU-ICAR to support vehicle and infrastructure testing.

The test locations are in less than 10 minute driving distance to CUICAR.



Support of WPT vehicle-infrastructure testing, preparation dynamic wireless charging research initiative (for higher speeds and power levels)



ITIC – the operator of a testbed to support the vehicle and the infrastructure of the future



Resurfacing of 1 mile runway completed for vehicle testing, shared office and vehicle lab space, preparations for wireless charging infrastructure for EV's



Urban track testing scenarios for connected vehicles and automated driving

Private office and lab space, secure vehicle storage and exhibition capabilities available



Long-distance highway track testing along I-185 (highway can be closed for public traffic)





THANK YOU !