Dynamic Wireless Power Transfer (DWPT) Feasibility Study

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

Timeline

• Start – Nov FY13 (FY12 funds)
• Finish – Sep FY13
• 40% complete

Barriers

Electric Vehicle adoption impacted by:

• Cost, weight and range impacts of ESS
• Static Wireless Power Transfer (WPT) is in developing stages with multiple incompatible hardware systems
• J2954 progression noting conflicting goals from different industries
• Grid support and impact

Budget

• Total project funding
  – DOE share – 100%
• Funding to ORNL for FY12: $225
• Funding for FY13: $0K

Partners

• Idaho National Laboratory
• Argonne National Laboratory
• National Renewables Energy Laboratory
• DOT
Project Objective

• Overall Objective
  – To identify major opportunities, impacts and barriers to the adoption of wireless power transfer (WPT) for vehicles in-motion. Commonly referred to as dynamic wireless power transfer. (DWPT)
  – Identify critical characteristics required for DWPT & shape future research and create necessary partnerships for this paradigm in transportation technology to occur outside of railed vehicles.
  – Identify implementations/Deployments of DWPT with highest probability of success and best return on investment which allow maturity of the technology and determine different use case feasibility.

• FY13 Objective
  – All objectives to be completed in FY13 timeframe.
<table>
<thead>
<tr>
<th>Date</th>
<th>Milestones and Go/No-Go Decisions</th>
<th>Status</th>
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<tbody>
<tr>
<td>Nov-2012</td>
<td>Milestone: Kick-off meeting and individual lab focus areas defined</td>
<td>Complete</td>
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<tr>
<td>July 2013</td>
<td>Milestone: Summary presentation to DOE</td>
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<tr>
<td>Sept-2013</td>
<td>Go/No-Go decision: Final report to DOE</td>
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Strategy

Lessons learned from previous grid connected and wireless activities drove the need for this type of study:

- Thorough understanding of current research of technologies and characteristics used for quantitative comparisons

- Develop scenarios for deployment, identify Scenarios of Interest (SOI)

- Determine technology readiness, impact, applicability per SOI

- Verify basic power levels required and other key characteristics of SOI
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Current Technology Assessment

- **Static WPT Commercial Products Limited Availability**
  - System OEMs nearing production
  - Cost and deployment impacts still studied
  - Communications guidelines/topics

- **Dynamic WPT**
  - Transportation topic since 1970’s
  - Mid 2000’s short route fleet conversions to BEV
  - KAIST first demonstrated its On Line Electric Vehicle system OLEV in 2009

http://www.electricvehiclesresearch.com/
Basic Scenario Identification

• Considerations for DWPT deployment
  – Environmental/Vehicle load impacts to roadway and WPT tech
  – Road modification traffic interruption, maintenance changes
  – Roadway usage, speeds, time of day

• Example Scenario- LDV Stem Route
  – HOV lane stem route metropolitan highway
  – Road usage high percentage VMT
  – Speeds varied ➔ higher speed/higher power
  – Replacing high power consumption portion of trip with charging opportunity, maximizes range and reduces ESS size and weight
  – System failure impact, traffic, range and routing

http://www.sigalert.com/
Scenarios of Interest

• **Metric Development**
  – Quantitative analysis requires comparable parameters for varied technologies
  – Freight analysis simplified?:
    • person/km/cost
    • cost/km/kW

• **Evaluation**
  – Complete cost analysis and petroleum reduction vs investment for SOIs using technology efficiency projections and traffic flow impact studies
  – Predict maintenance and cost impact for leading SOI
  – Formulate study parameters for DOT focus area
  – Identify barriers and risks for SOIs with best ROI within transportation sector
DOE Field and Dyno Data Use

Utilized data from INL’s AVTA and ANLs APRF testing:

- On-going advanced vehicle evaluation and testing activities
- Vehicle list updated with latest production based advanced technologies
- Determine in-use power over variety of speed and use criteria
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Field data fills in gap from test cycle data
<table>
<thead>
<tr>
<th>Organization</th>
<th>Type of Collaboration/Coordination</th>
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</thead>
<tbody>
<tr>
<td>National Renewable Energy Laboratory</td>
<td>Advanced MD/HD Vehicle field data power requirements. Road use analysis and infrastructure cost</td>
</tr>
<tr>
<td>Argonne National Laboratory</td>
<td>Coordinated chassis dyno testing results with INL field test data for LDV power requirements. Also linked to J2954 standards for communications progress</td>
</tr>
<tr>
<td>Idaho National Laboratory</td>
<td>Coordinated field data testing results with ANL chassis dyno test data for LDV power requirements.</td>
</tr>
<tr>
<td>DOT</td>
<td>Estimations of road impact and embedded technology durability</td>
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Summary

• Relevance
  – Mass adoption of grid powered electric vehicles is being curtailed partly due to range anxiety, utility factor and cost of large Energy Storage Systems
  – Electrified roadways offer extended use of pure electric vehicles and large potential oil displacement, however the investment must be shown to have significant benefit

• Approach
  – Determine in-use power requirements for various vehicle applications
  – Define implementation strategies for dynamic wireless power transfer (DWPT), evaluate potential costs, barriers and benefits of various scenarios
  – Compare various technologies to determine which are capable of DWPT based on given assumptions

• Technical accomplishments and Progress
  – Literature search and DWPT application baseline determination
  – Developed scenarios of interest (SOIs) and evaluation criteria

• Collaborations:
  – INL, ANL, NREL and DOT

• Future Work: (rest of FY13)
  – Complete scenario evaluations and presentation to DOE and project report
Acknowledgements & Team Members

• Argonne National Laboratory
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Technical Back-Up Slides
Technologies for comparison

• Organizations currently researching Dynamic Wireless Power Transfer
  – Momentum Dynamics USU
  – Qual Comm/Halo IPT
  – ORNL
  – Bombardier
  – KAIST
  – Conductix
  – Seimens