NREL
NATIONAL RENEWABLE ENERGY LABORATORY

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Transformational LDRD: Connected and Intelligent Urban Mobility

Principal Investigators: Kevin Walkowicz, Stan Young, Tony Markel, Jeff Gonder (Transportation and Hydrogen Systems Center)
Key Contributors: Andrew Meintz (THSC Engineer), Kate Doubleday (RPP Intern CU Boulder), Yuche Chen (THSC Engineer), Yunfei Hou (The State University of New York at Buffalo), Xuewei Qi (RPP Intern UC Riverside) June 19, 2015

OVERVIEW

OBJECTIVES

Develop NREL's role as a leader in the use of connected and intelligent vehicle and transportation system designs to reduce transportation energy use.

APPROACH

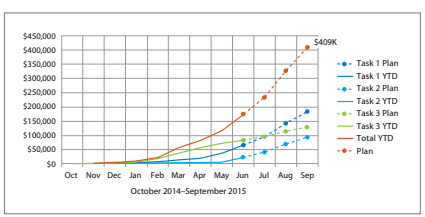
- Develop in-house expertise in intelligent vehicle and transportation system design.
- Develop data and tools to explore and analyze the interplay between vehicle connectivity, automation, driver behavior, urban form, and energy consumption.
- Explore and demonstrate pathways to intelligent vehicle electrification enabled by wireless power transfer technologies.

EXPECTED OUTCOMES

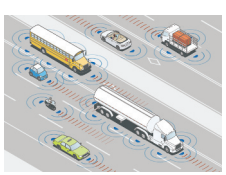
- Develop an in-house team to lead and execute efforts related to urban mobility and vehicle connectivity.
- Execute key research projects to develop new partnership and funding opportunities in connected and intelligent urban mobility.
- Design, develop, and demonstrate a wirelessly charged campus shuttle system that uses intelligent and connected technology to efficiently and effectively integrate with the "smart grid."

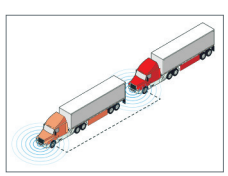
BUDGET AND PERIOD OF PERFORMANCE

Period of Performance
Year 1: January 2015–September 2015 ($409k)
Year 2: October 2015–September 2016 ($445k requested)

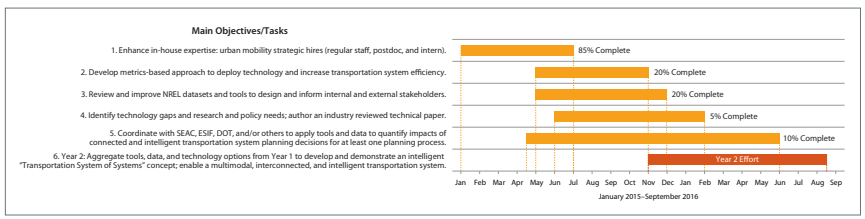


FY 2015





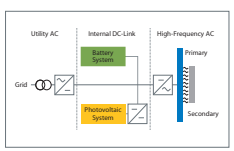
CONNECTED AND INTELLIGENT URBAN MOBILITY: IN-HOUSE EFFORTS TO DEVELOP EXPERTISE AND PERFORM COLLABORATIVE RESEARCH

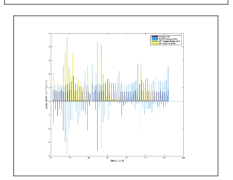


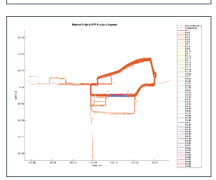
INTELLIGENT INDUCTIVE CHARGING: ANALYSIS AND SUPPORT TO DEVELOP NREL ON-CAMPUS DEMONSTRATION

OBJECTIVES

- Cross-platform integration of in-motion and static WPT technologies to increase utilization of infrastructure supporting HD, MD, and LD vehicles.
- Strategy that enables vehicle electrification benefits with much smaller batteries, applicable to HEVs, PHEVs, and EVs.
- Grid integration of electronics usage to enable greater integration of renewables either by aligning loads with generation or utilizing power quality enhancing functions.







PROGRESS/ACCOMPLISHMENTS

- Operational data for the NREL campus shuttles have been collected to provide insights into current usage patterns; travel patterns used with vehicle simulation tools to understand the relationship between battery pack sizing, stop times, and charging system attributes.
- Structure of the modeling tools will enable the evaluation of power grid integration analysis where multiple transfer units are laid out along a roadway supporting power transfer to multiple vehicles while in-motion.
- WPT has been specified and ordered, donor/demo vehicles secured, and site analysis and design work underway.

PROJECT EFFORTS

- FY 2015 Q1–3: Data collection, analysis, and modeling
- FY 2015 Q3–4/FY 2016 Q1–3: Systems integration planning, testing, and evaluation
- FY 2016 Q3–4: Reporting on tech assessment and campus implementation benefits and strategy.

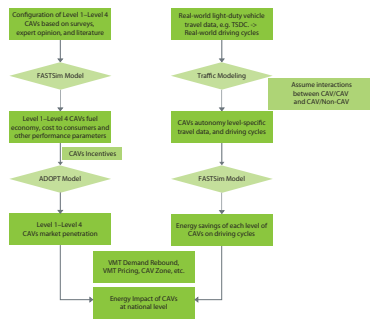
TESTING AND DEMONSTRATION PHASE

- Industry collaborations are in progress with Smith EV and OLEV Technologies.
- The Smith EVs will be leveraged from a past DOD vehicle-to-grid project. The OLEV WPT systems, currently in use in Korea for dynamic wireless power to transit buses, will provide between 20–50 kW to the vehicle in our planned evaluation.
- Test hardware will be installed at VTIF to leverage the ability to integrate with simulated and real solar and energy storage systems. FY 2016 efforts will be to advise on design and build out system on NREL campus.

MAJOR ACCOMPLISHMENTS

CONNECTED AND INTELLIGENT URBAN MOBILITY ACCOMPLISHMENTS TO DATE (BY OBJECTIVE)

1. **Enhance expertise:** Stan Young, Yuche Chen, and Xuewei Qi hired. Additional postdoc and subcontract with SUNY Buffalo in process.
2. **Develop metric-based approach:** Process/protocol to utilize existing NREL tools (FASTSim and ADOPT) has been drafted and is being refined. Will further refine and optimize energy use of connected and automated vehicles.
3. **Refine dataset and tool:** Collaborate with University of Buffalo to explore Cooperative Vehicle and Intersection Control Strategies. Strength of current data are highly granular space/time vehicle profiles. Need to add broad-base, spatially ubiquitous data inventories for planning-level analysis; partner with the likes of INRIX and University of Maryland.
4. **Identify gaps and needs:** Preliminary research being done to explore current state of the art.
5. **Coordinate and partner:** Planning collaboration with Volvo Car Group to perform analysis on 100-car automated demo; additional discussions with industry and research institutions such as Ford, GM, TomTom, DOT FHWA, SUNY Bufffalo, UMTRI, and others.



POTENTIAL AND PENDING FUTURE FUNDING OPPORTUNITIES

CONNECTED AND INTELLIGENT URBAN MOBILITY

- DOE Lab Call on connected and automated vehicle energy impacts
- ARPA-E TRANSNET FOA
- DOT Connected Vehicle Pilots and ARPA-E Open FOAs (Applications with Connected Signals)
- DOD Interagency Agreement for Autonomy-Enabled Fuel Savings in Military Vehicles
- DOT AERIS/Connected Cities collaboration
- Partnership discussions with Ford and GM

INTELLIGENT AND INDUCTIVE CHARGING

- DOT vehicle demonstration pilots
- CA Agency (SCAQMD/CEC/ARB) truck and bus demonstrations
- Utah state and European agencies for pilot technology evaluations
- DOE EERE Grid Modernization Lab Call
- Airport shuttles, delivery, and transit agencies fleet electrification efforts

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Golden, Colorado
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