Grid Connected Functionality

2015 Building Technologies Office Peer Review

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

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Project Summary

Timeline:

Start date: February 5, 2015

Planned end date: September 30, 2015

Key Milestones

1. Develop Scoping Studies for High-Value Transactional Applications; 2/23/2015
2. Demonstration of ESIF VOLTTRON Infrastructure; 6/30/2015

Budget:

Total DOE $ to date: $590k

Total future DOE $: $450k

Target Market/Audience:

Connected Building Equipment Industry

Key Partners:

Pacific Northwest National Laboratory
Robert Bosch, LLC
Virginia Tech

Project Goal:

The objective of Grid Connected Functionality is to develop planning and establish strategic directions, along with supporting framework documents vetted by public engagement with industry and other stakeholders, which support and inform future research, development and deployment of critical building-grid transactional frameworks.

Purpose and Objectives

Problem Statement: Today's building equipment is neither interoperable nor operated as efficiently as possible. In the near future, connected building equipment, service providers and grid services are expected shift the market landscape. Building Technologies Office (BTO) wants to be ready to support these market opportunities.

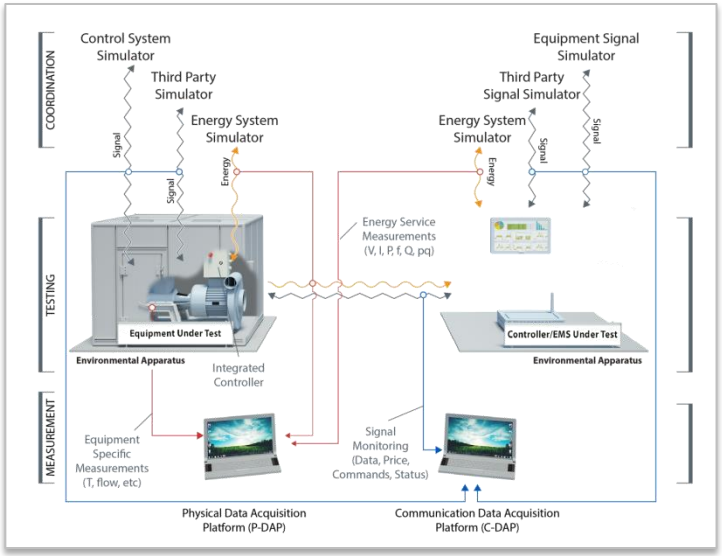
Target Market and Audience: NREL's work supports BTO with technical scoping studies related to BTO's strategic directions. This project also establishes key capabilities and infrastructure which supports future developments by the connected building equipment industry.

Impact of Project: The project will further improve BTO's engagement with the emerging market for connected building systems and related services, and will clearly define near-term research opportunities which BTO can pursue.

Task1 – Equipment Characterization

Summary: Support BTO's public process to establish Characterization procedures for connected building equipment.

Approach: DOE is pursuing an open/transparent process for characterization protocols for providing services following a regulatory process of publish and comment. NREL's will specify "test rigs" – minimum viable apparatuses for industry to duplicate DOE's characterization protocols.



Key Issues: Uncertainty about capabilities, value and cost-effectiveness of emerging connected building systems and products.

Distinctive Characteristics: NREL is focused on minimizing the burden on industry which will enhance adoption of the voluntary protocols. The Characterization methods will be piloted in Energy Systems Integration Facility (ESIF)

Outcomes: NREL has drafted a public document outlining the minimum viable characterization test rig for DOE's publication. NREL will address public comments and will redraft the public document for DOE publication.

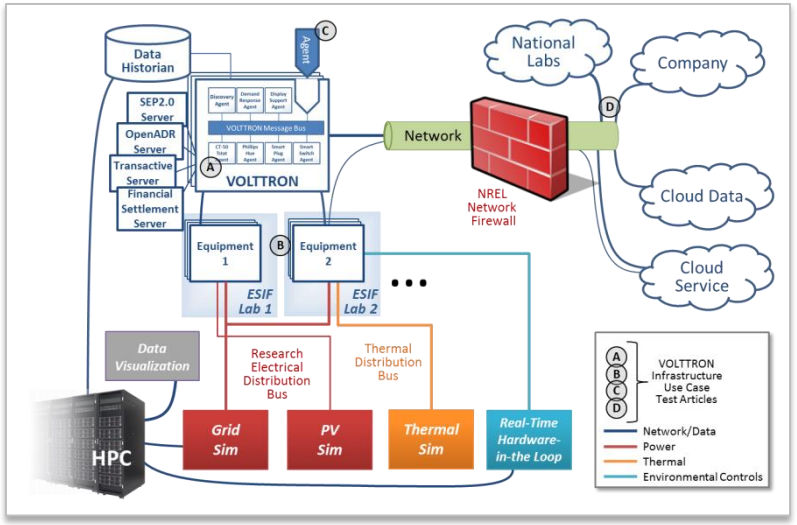
Impact: Consensus methods will result in consistent descriptions of capabilities and metrics, reduce market uncertainty about value of connectedness, and accelerate product adoption.

Task 2 – Establish Transactive Network Infrastructure in ESIF

Summary: Develop and demonstrate integration of VOLTTRON controls and capabilities with NREL's Energy Systems Integration Facility (ESIF)

Approach: The proposed VOLTTRON Infrastructure has hardware and software components which enable test and validation of four types of test article:

A. Standalone VOLTTRON Systems,
B. Equipment,
C. Algorithms & Agents, and
D. Multi-Site VOLTTRON Interactivity



Key Issues: NREL is leveraging the VOLTTRON platform to extend the ESIF testbed to facilitate transactional interaction of equipment, the grid, and software components.

Distinctive Characteristics: For the first time, this project will demonstrate VOLTTRON control of building equipment operating as Hardware-in-the-Loop.

Outcomes: NREL will deploy and demonstrate the VOLTTRON Infrastructure throughout ESIF. NREL will support merit review of the Infrastructure installation. The Infrastructure will then become part of the ESIF Technical User Facility and can be accessed by researchers and industry.

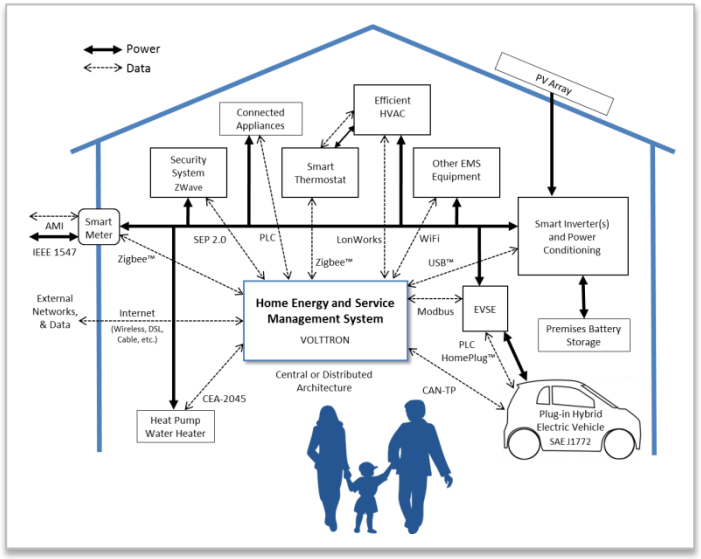
Impact: Risk reduction through validation of equipment and controls under contingency situations prior to fielding products in real buildings or power systems.

Task 3 – Home Energy Management Vision whitepaper

Summary: Support BTO in developing a whitepaper on DOE's Vision for Home Energy Management (HEM)

Approach: NREL will support the BTO Grid Integration Residential Buildings Integration teams in development of a draft HEM white paper which describes:

- What HEM is and what HEM is not,
- DOE's vision for HEM,
- DOE's role (what DOE should do and what we should not do),
- Illustrative examples or market examples of HEM and why it is important, and
- DOE's next steps in HEM



Key Issues: Lack of clarity around DOE's role in "Smart Home" space, a rapidly-evolving market

Distinctive Characteristics: NREL's expertise in residential building research, and its unique laboratories focused on connected homes and neighborhoods

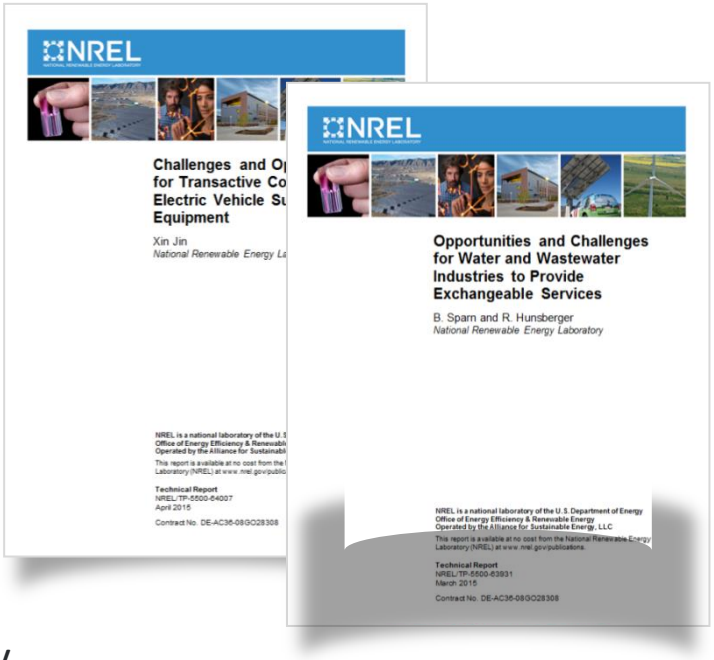
Outcomes: NREL will support a DOE whitepaper, and prepare a market survey appendix to that whitepaper. NREL will scope how BTO can support industry by development of HEM in VOLTTRON and accommodation of industry efforts (i.e. THREAD, HOMEKIT, Haystack, AllSeen, etc.)

Impact: Defined vision, role and next steps for BTO in supporting the emerging Home Energy Management industry and connected residential equipment

Task 4 – Scope High-Value Applications

Summary: Scope future work on high-value applications:

- Building-connected EVSE (EV chargers)
- Municipal water/wastewater pumping systems



Approach: NREL researched building opportunities for workplace electric vehicle supply equipment (EVSE, or EV chargers), as well as municipal water and wastewater systems, and has identified practical near-term R&D opportunities.

Key Issues: These two categories of equipment have strong potential for transactional services, providing additional value streams which are not being accessed today.

Distinctive Characteristics: NREL is a leader in energy systems integration, including building systems integration and vehicle integration with our power systems.

Outcomes: NREL has delivered draft scoping studies to BTO and is currently performing peer review of the documents for potential future publication.

Impact: Future applications of pumps and EVSEs will be able to access additional value streams, enhancing their market value and increasing adoption of technologies which support grid stability, carbon savings, and lower life cycle costs.

Progress and Accomplishments

Lessons Learned: Project has been underway for a short time – not yet applicable

Accomplishments:

- ***Task 1:*** NREL supported one BTO public meeting on Characterization thus far
- ***Task 2:*** NREL has developed a Work Plan for implementing and demonstrating VOLTTRON Infrastructure in ESIF
- ***Task 3:*** NREL support for BTO's Home Energy Management Vision whitepaper is underway; no accomplishments yet
- ***Task 4:*** NREL developed two Scoping Studies for BTO

Market Impact: No market impact has yet occurred, due to the recent project start.

Awards/Recognition: None yet, due to the recent project start.

Project Integration and Collaboration

Project Integration: On each task, NREL and BTO are engaging with industry, academia, other research organizations and the public.

- ***Task 1:*** NREL supported BTO in an open public meeting on Characterization
- ***Task 2:*** NREL has engaged with VOLTTRON developers at PNNL, VOLTTRON users at Virginia Tech, and a major building equipment manufacturer (Bosch)
- ***Task 3:*** NREL's participation in industry organizations (AllSeen Alliance, Thread, SGIP, CEE, etc.) and its longstanding experience with the home builder and equipment industries provide ample opportunity for market-connected work
- ***Task 4:*** NREL collected information from several EVSE manufacturers (through our colleagues in the Vehicles Technology research area), water utilities, and NREL's Market Deployment team, in development of the draft scoping studies.

Partners, Subcontractors, and Collaborators: While we have many industry advisors on various portions of the project, Task 2 is the primary opportunity for collaboration.

- **PNNL** is supporting NREL as part of their VOLTTRON platform development
- **Virginia Tech** is supporting NREL's demonstration of their VOLTTRON BEM system
- **Bosch** is contributing connected equipment to NREL's other demonstration

Communications: This project has been underway only a short time. For Task 1, NREL supported a BTO public meeting. No other external communication of results has occurred.

Next Steps and Future Plans

Next Steps and Future Plans: Pending approval of Go/No-Go milestones:

1. NREL will continue to support BTO's public meetings on Characterization of equipment, including potentially developing and demonstrating the consensus procedures and apparatus that results.
2. NREL will deploy VOLTTRON throughout ESIF and demonstrate the infrastructure's functionality.

REFERENCE SLIDES

Project Budget

Project Budget: $1.03M: $580k + $450k pending work (to be funded based on Go/No Go's)

Variances: No variances have occurred from the original budget plan.

Cost to Date: $320k

Additional Funding: None

Period of Performance: 2/5/2015 through 9/30/3015

Budget History					
Insert Start Date – FY2014 (past)		FY2015 (current)		FY2016 – Insert End Date (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
		$1.03M			

Project Plan and Schedule

Tasks 1, 2, and 3 rely on Go/No Go decisions for continuation to the end of the project year. Task 4 concludes with the completion of the Scoping Studies.

There are 15 milestones and deliverables associated with the project; major milestones are shown below.