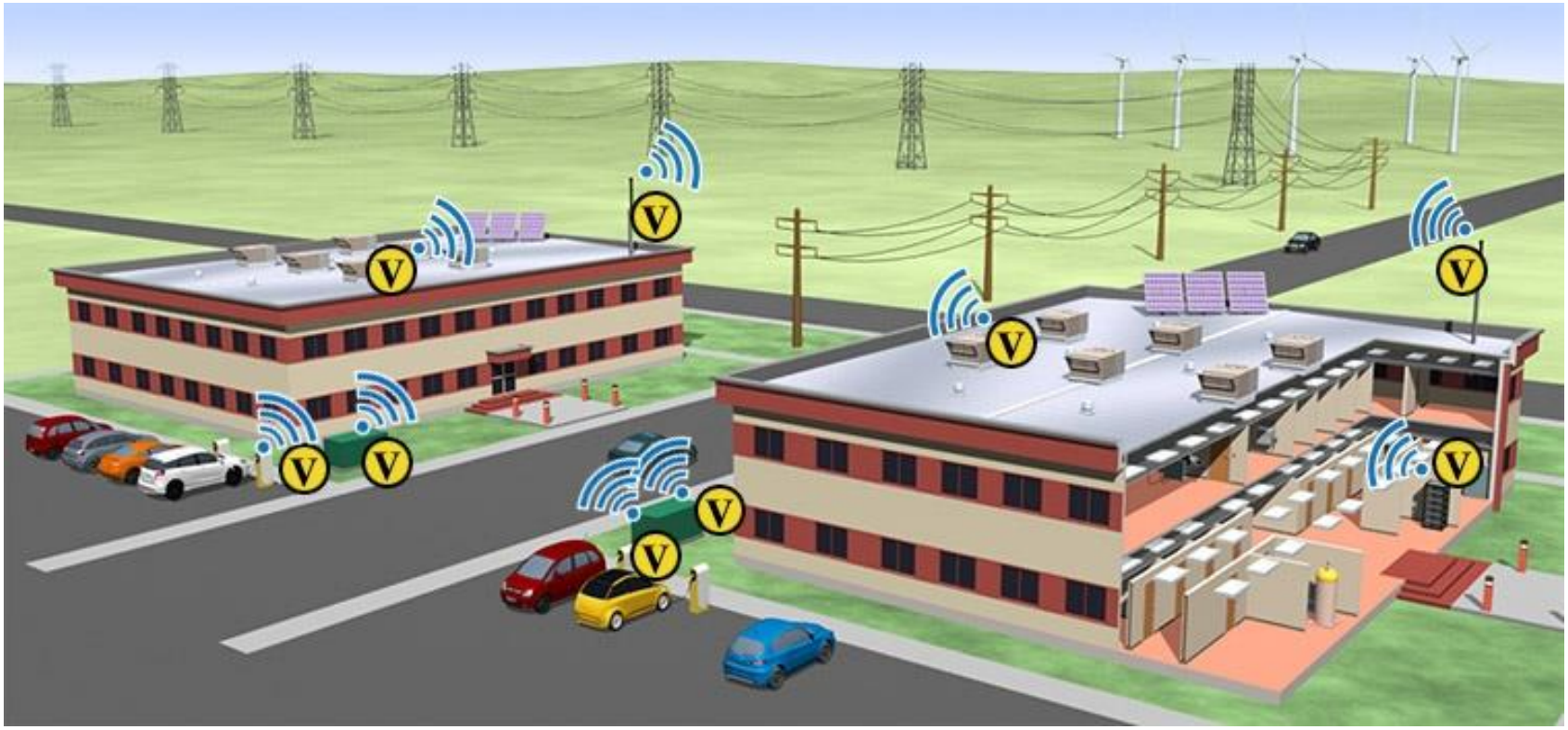
VOLTTRON™ Commercialization

2015 Building Technologies Office Peer Review



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VOLTTRON Commercialization Project Summary

Timeline:

Start date: 10/1/2014 (New Project)

Planned end date: 9/30/2017

Key Milestones

1. Complete market assessment for a VOLTTRON based product for small- and medium-sized commercial buildings market; April 2015
2. Development of VOLTTRON-based product; August 2015

Budget:

Total DOE $ to date: $350K ($15.5K + 65K cost-share)

Total future DOE $: TBD

Target Market/Audience:

In FY15, target market is small- and medium-sized commercial buildings, but in later years market will expand to include all residential/commercial. Major users are energy service providers and 3rd party aggregators of grid services.

Key Partners:

Transformative Wave Technologies (TW)	Navigant*

*Navigant has complementary task related to this work, but they are not funded through this effort

Project Goal:

The main goal is to transfer VOLTTRON software to selected private sector partners and help them create a product/service that will **improve the operating efficiency of buildings and increase the resilience of the electric grid**. In FY15, working with TW, PNNL will transfer VOLTTRON™ software platform so TW can create a VOLTTRON-based product offering for small/medium-sized commercial buildings. An important secondary goal is to develop a publicly available "how to" best practice guide for small- and medium-sized commercial buildings to encourage replication at scale by other potential private sector vendors.

VOLTTRON: Purpose or the Challenge

- Improving operating efficiency of homes and buildings
  - Diagnostic and maintenance services
- Providing grid services across buildings and the grid
  - Smart loads in homes, offices, industry
  - Potential for millions of electric vehicles
  - Distributed renewable energy
  - Reliability and security

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VOLTTRON: Industry Needs

Technology

- Methods for generating actionable information with large amounts of data
- Scalable and fault-tolerant control and diagnostics
- Secure and reliable communication
- Cross-vendor “App Store” for best-of-breed energy applications
  - Current approach is tight, vertical integration of single-vendor products
- Compatibility with evolving standards landscape for transactive energy
- A reference platform for R&D use

Application

- Ability to manage and “optimizing” end-use loads
- Ability to improve end-use operational efficiencies
- Integrating energy storage at multiple layers
- Enabling energy coordination and trading between buildings and between buildings and grid

Objectives, Target Market and Audience

Objective: The main goal of the project is to transfer VOLTTRON software to:

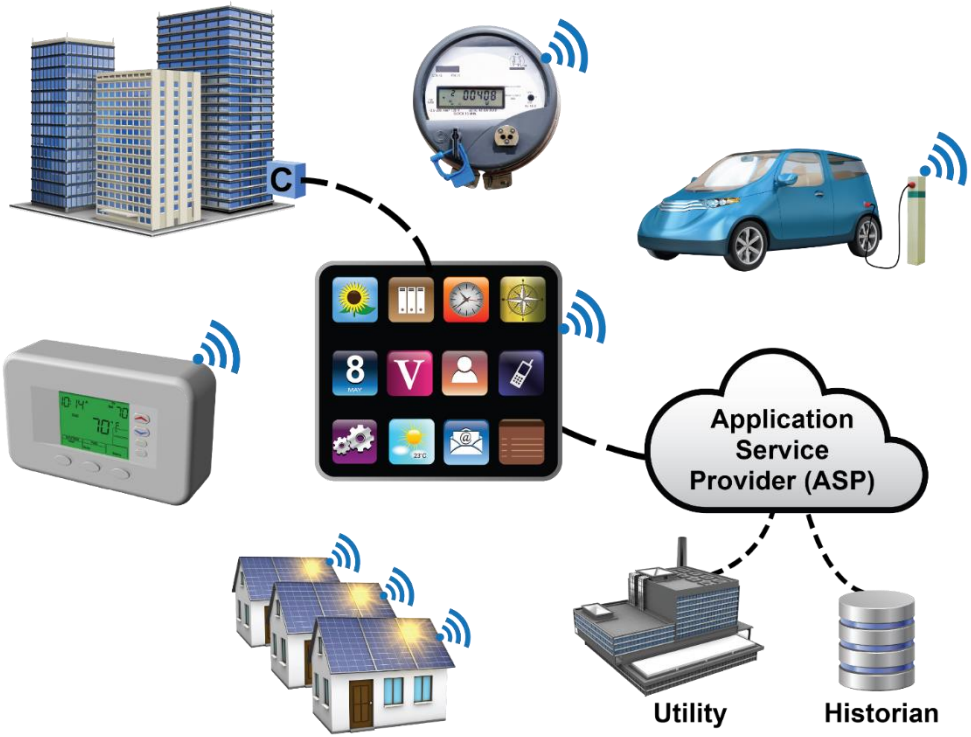
- Selected private sector partners and help them create a product/service
  - To improve the operating efficiency of buildings and increase the resilience of the electric grid at scale and cost-effectively
- An important secondary goal is to develop a publicly available "how to" best practice guide for small- and medium-sized commercial buildings
  - To encourage replication at scale by other potential private sector vendors

Target Market and Audience:

- In FY15, target market is small- and medium-sized commercial buildings (between 8 and 10 quads of primary energy consumption)
- In the subsequent years, the market will include all buildings residential and commercial (38 quads)
- Audience are energy service providers and 3rd party aggregators of grid services

What is VOLTTRON?

- VOLLTRON is an application platform (e.g., Android, iOS) for distributed sensing, monitoring and controls applications
- It includes a suite of applications already implemented to perform transactions for improving energy efficiency and providing grid services



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What VOLTTRON is NOT

- A fully realized commercial grade product with a suite of applications already implemented to perform transactions
  - It enables application development, but in and of itself, it is not an energy efficiency solution
- A protocol
  - Protocols, such as SEP 2.0. (Smart Energy Profile) or OpenADR, are implemented as applications
- An application, such as demand response
  - DR can be implemented as an application

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Impact of Project

- **Project Outcomes**:
  - Complete market assessment for a VOLTTRON-based product for small- and medium-sized commercial buildings market
  - Development of VOLTTRON-based product
  - Complete pilot testing of the VOLTTRON-based product
  - Develop a publicly available "how to" best practice guide for small- and medium-sized commercial buildings
- **In FY15**: working with TW, develop and deploy VOLTTRON-based efficiency and grid services in small-/medium-sized buildings
- **Near-term**: (first year after deployment) the goal is for TW to deploy VOLTTRON-based services in 10 to 20 buildings and prove market for such an offering exists
- **Mid-term** (2 to 3 years) goal: recruit 2 to 3 more private sector companies offering VOLTTRON-based products that cover all buildings (residential and commercial)
- **Long-term** (> 3years): anticipate deployment of VOLTTRON-based products to grow exponentially

Approach

Approach: The project team collaboratively is developing and pilot testing a VOLTTRON-based product

- TW will develop the VOLTTRON-based product (VBP) and integrate it with their small-/medium-size building offering; TW will deploy the product offering through their distribution channels; TW will assess market and develop a business plan
- PNNL role is to provide technical support to TW, design the pilot demonstrations and evaluate the response from the pilots

Key Issues:

- Selection of the pilot sites and deploying the VOLTTRON-based product in a tamely manner would be a key challenge

Distinctive Characteristics: VOLTTRON platform and the associated applications have been released as open source

- Agent execution platform for distributed sensing, monitoring and controls
- Allows secure communication between the buildings and grid
- Number of users and contributors already

Progress and Accomplishments

Accomplishments to date – by TW:

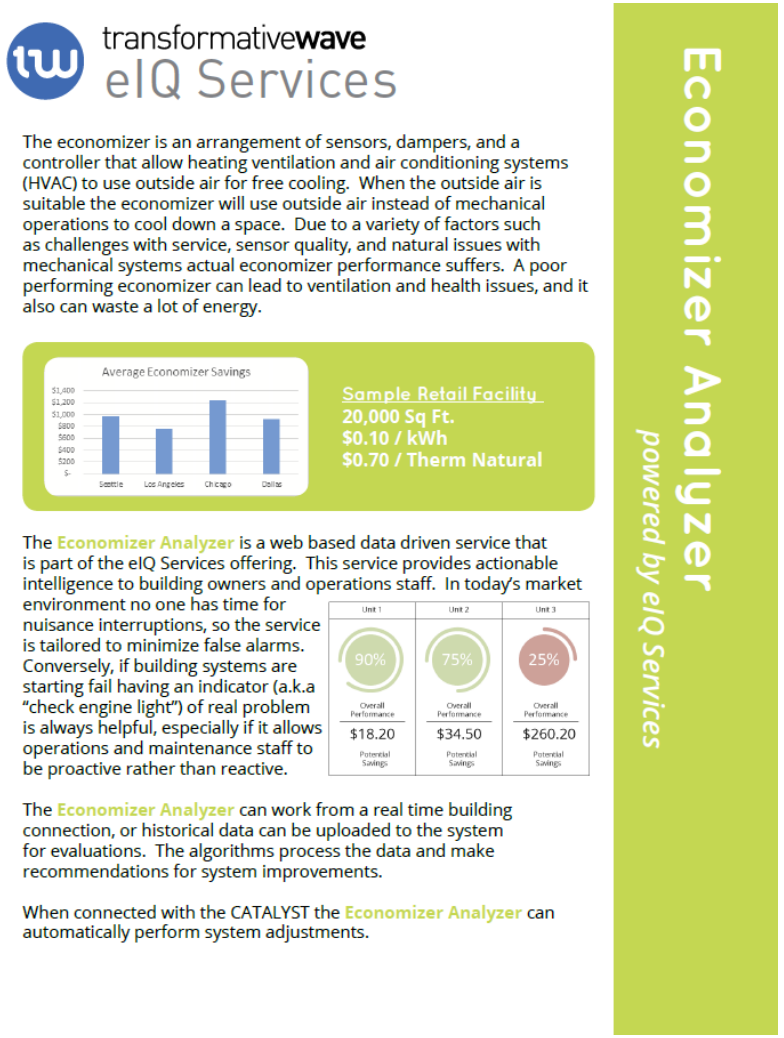
- Defined the VOLTTRON-based product they are developing
- Developed a market assessment questionnaire they will launch later this month;
- Started creating the product itself

Market Impact: This is a new project, so no quantitative metrics are yet available. Anecdotal information from TW and their distribution network has been positive.

Awards/Recognition: None at this time

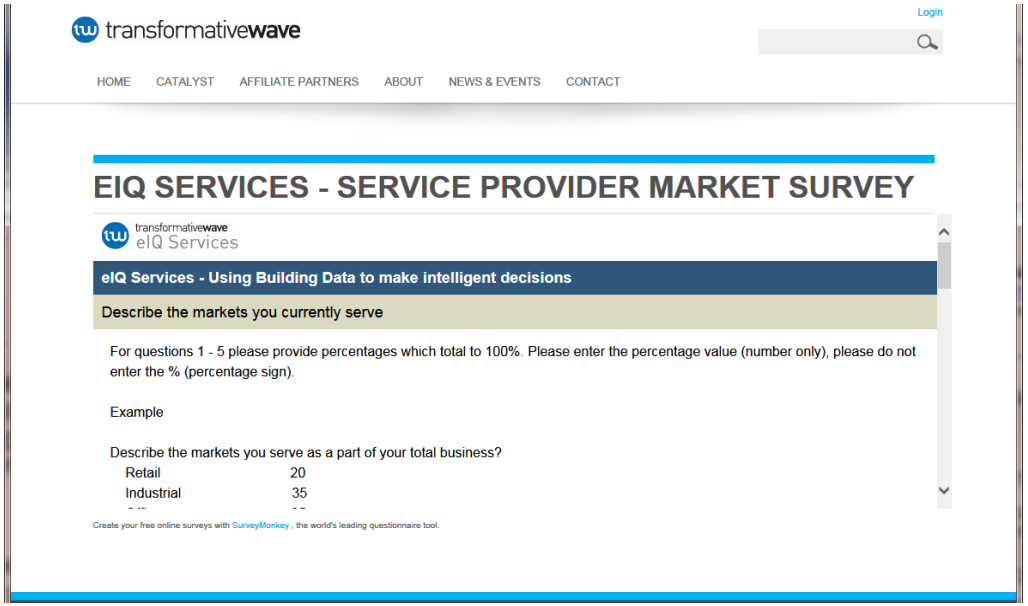
TW Progress

- Defined the VOLTTRON-based product
- Created a set of brochures to describe the product
- Created market assessment survey:
  - End user
  - Utility
  - Service provider



TW Next Steps

- Complete survey by end of April
- Prototype VOLTTRON-based product end of May
- Complete business plan by end of May
- Initiate pilot testing of VOLTTRON product – May



Project Integration and Collaboration

Project Integration: PNNL is actively collaborating with both TW and Navigant and has also talked to a number of other potential partners who are also interested in commercializing VOLTTRON for other markets

Partners, Subcontractors, and Collaborators:

- TW, a small HVAC business from Washington state, is the main project partner and is developing the VOLTTRON-based product
- Navigant has a separately-funded but related effort to document the VOLTTRON market.

Communications:

- Held two technical and early adopter meetings in FY14 and another is planned for later this year
- A number of publicly available technical papers on VOLTTRON are available
- VOLTTRON software has been presented to a number of potential users and commercializers (universities, energy service providers, etc.)
- A user guide was also created to help early adopters

Next Steps and Future Plans

Next Steps and Future Plans: The first step is to successfully complete the FY15 planned activities:

- Create VOLTTRON-based product
- Develop market assessment and business plan for deploying VOLTTRON-based product in small- and medium-sized commercial building sector
- Pilot test the product and evaluate the response
- Develop a publicly-available “how to” best practice guide

- Under separate funding, Navigant is currently conducting a much broader market assessment for VOLTTRON for both buildings and grid application
  - PNNL will review Navigant’s work and identify additional markets and commercializers to work with in FY16

Navigant Overview: VOLTTRON Market Assessment

Investigation & Evaluation of Markets

Deployment Strategy & Next Steps

1	2	3	4
Identify Potential Applications and Markets	**Evaluate and Rank Applications and Markets**	**Characterize and Evaluate Most-Promising Markets**	**Strategy Recommenda-tions and Other Conclusions**
Prepare master list of applications and markets through: • Review of VOLTTRON materials • Navigant subject matter expert brainstorming Develop initial characterization and screening criteria	Characterize performance parameters and metrics for VOLTTRON and each application Score, map, and analyze each application and market	Further characterize the most promising markets, including existing players and competing products Identify market entry points, propagation pathways, and key decision makers within each application and market	Assess various strategies to introduce VOLTTRON to priority market segments Outline additional DOE activities for technology demonstration and support

Navigant: Potential Markets and Applications

- Navigant identified 45 applications for VOLTTRON based on their internal brainstorming and also using PNNL developed use cases
- The applications fall into 7 major categories:
  - Multi-directional energy systems (6)
  - Wide-area asset monitoring (4)
  - Advanced data collection and benchmarking (4)
  - Grid/utility services (7)
  - Connected building operations (14)
  - Financial and asset exchanges applications (6)
  - Smart cities (4)
- Classified VOLTTRON markets as grid or non-grid

Gaining Research Acceptance & Increasing Commercial Interest

A National User Community

Oak Ridge National Laboratory

NREL

Berkeley Lab
Lawrence Berkeley National Laboratory

Virginia Tech

Drexel University

Case Western Reserve University
Est. 1826

UTSA
University of Texas at San Antonio

Montana State

Fresno State
California State University, Fresno

University of Victoria

State University of New York at Binghamton
Unity Identity Excellence
1946

Commercial Users

transformativewave

Siemens

Energy Analytics

Energy Analytics & Consulting

Emerson Climate Technologies

Johnson Controls

MelRok

BOSCH

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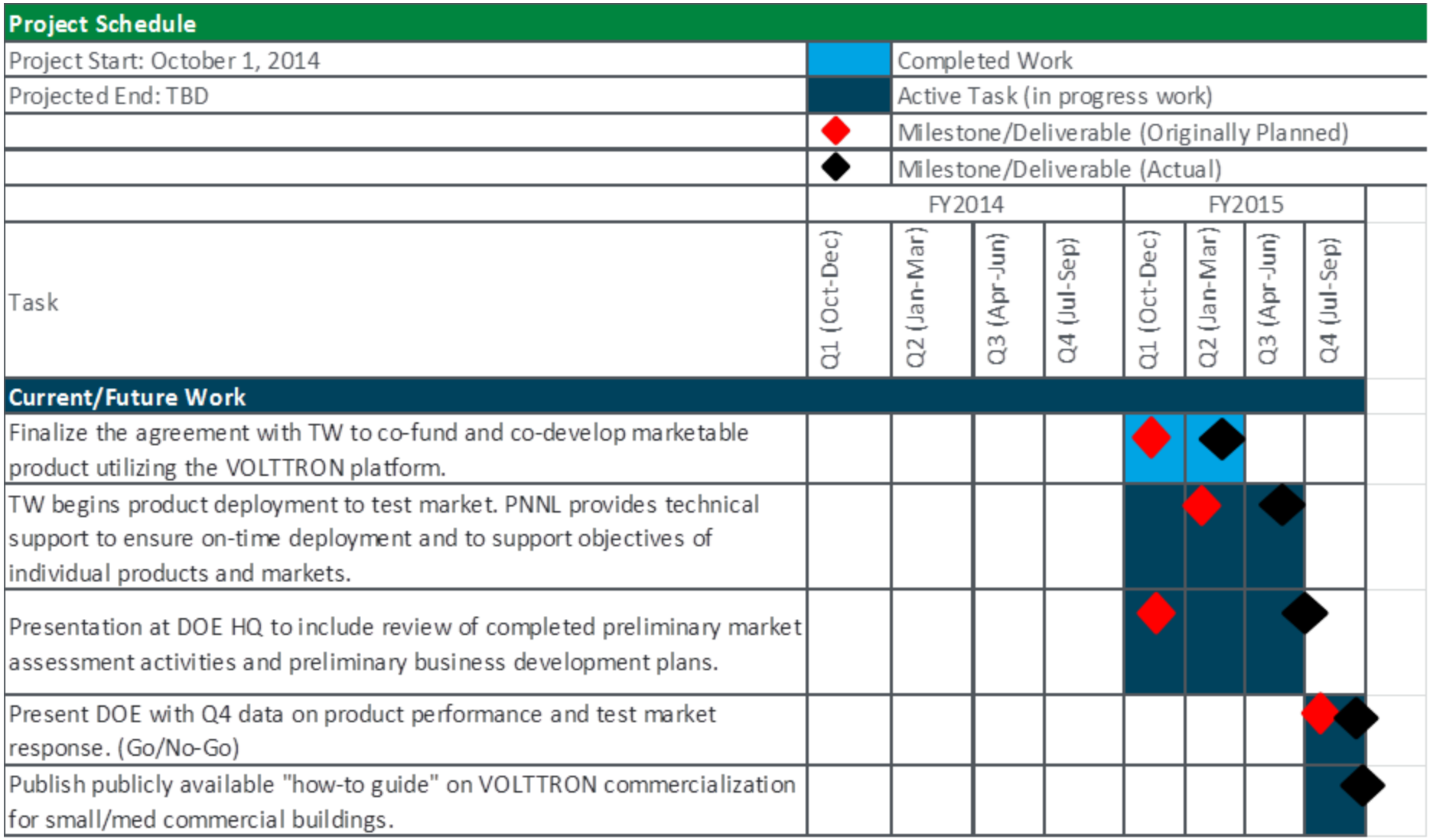
Project Budget

Project Budget: This is a new start deployment project within CBI.
Variances: PNNL has received the full anticipated budget of $350K.
Cost to Date: As of 3/20/2015, $21K has been expended. Of the total budget, $55K is committed to TW.
Additional Funding: Not applicable.

Budget History					
FY2013– FY2014 (past)		FY2015 (current)		FY2016 – TBD (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$0K	$0K	$350K	$15.5K[1]	TBD[2]	TBD

1 *Additional $65K of cost-share is anticipated once pilot testing is authorized to commence.*

2 *By DOE based on FY15 results.*

Project Plan and Schedule