CBEI Transitioning Technology to Market

2015 Building Technologies Office Peer Review

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

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Project Summary

Timeline:

Start date: 5/01/2014

Planned end date: 4/30/2016

Key Partners:

United Technologies Research Center (UTRC)
Penn State University
Booz Allen Hamilton

Key Milestones

1. List of technologies for further market study, 7/18/2014
2. Summarize results of deployment and lessons learned in report, 4/16/2015
3. Finalize report, 4/30/2015

Budget*:

Total DOE $ to date: $293,700

Total future DOE $: $349,745

Project Goals:

- Support deployment of all CBEI project solutions into the market
- Identify market opportunities and challenges that affect technology commercialization for three identified technologies

Target Market/Audience:

Service Providers

Manufacturers

Utilities

****Technologies covered are different between BP4 (controls) and BP5 (shading and window attachments)***

CBEI CONSORTIUM for BUILDING ENERGY INNOVATION

Vision:

By 2030, deep energy retrofits that reduce energy use by 50% in existing SMSCB, which are less than 250,000 sq ft

Mission:

Develop, demonstrate and deploy technology systems and market pathways that permit early progress (20-30% energy use reductions) in Small and Medium Sized Commercial Buildings

Our Goals:

- **Enable deep energy retrofits** in small to medium sized commercial buildings
- **Demonstrate energy efficient systems** tailored for SMSCBs in occupied buildings – living labs
- **Develop effective market pathways** for energy efficiency with utilities and other commercial stakeholders: brokers, finance, service providers.
- **Provide analytical tools** to link state and local policies with utility efficiency programs

CBEI Partners

Industry

Bayer MaterialScience

United Technologies Research Center

Economic Development Organizations

DVIRC

PIDC

Ben Franklin Technology PArtners

Universities

PENNSTATE 1855

NJIT

Penn University of Pennsylvania

Drexel University

Carnegie Mellon University

VirginiaTech Invent the Future

Purdue University

Morgan State University

Rutgers

Purpose and Objectives

Problem Statement:
Pathways to market can be challenging for new efficiency solutions – whether deploying existing technologies/market solutions or commercializing new technologies

Target Market and Audience:

- Deployment and commercialization partners (e.g., service providers, utilities, manufacturers) need to be able to influence and understand the results of demonstrations for more efficient deployment/commercialization
- Solution developers (e.g., researchers) need an understanding of market opportunities and challenges and how they vary by market actor

Impact of Project:

1. Better approaches for researchers on deploying/commercializing solutions controls solutions
2. Greater uptake of CBEI solutions into the market as measured by interest in commercializing technologies and deploying solutions

Approach – Deployment

Approach

- Required all 29 CBEI project leads to identify market partners for feedback throughout development to increase likelihood of market interest at completion
- Worked with each project lead to review and provide feedback on deployment plans
- Connected with different market actors (e.g., utilities, service providers) to identify potential opportunities for collaboration with CBEI

Key Issues:

- Identifying entrepreneurial market actors willing to take the time to provide input and commit to be early adopters
- Lead time required to get commitment is often as long or longer than project lifecycle

Distinctive Characteristics:

- Continuous market engagement throughout project lifecycle

Progress and Accomplishments

Lessons Learned:

- The market lacks good opportunities to reach SMSCB retrofit providers because of the fragmented nature of the industry
- The key to getting market penetration in the SMSCB is through rebate programs, which often have substantial bureaucratic hurdles

Accomplishments:

- Explored opportunities for deployment with multiple energy efficiency program administrators
- Ensured projects were on track with a deployment strategy and deployment partners and supported exploration of deployment partners to expand reach

Market Impact:

- Built stronger relationships within the program administrator community for feedback on current and future research and potential pipeline as solutions are finalized

Awards/Recognition:

- None

Approach – Commercialization

Approach:

- Worked with CBEI project leads, technology developers, and external stakeholders with technical expertise to identify technologies with market readiness
- Selected two technologies currently demonstrating strong potential for commercialization:
  - RTU Optimization
  - Fault Detection and Diagnostics for Air Handling Units
- Conducted interviews of potential market partners for deployment and commercialization to understand opportunities and potential barriers to deployment/commercialization
  - Synthesized key findings from interviews to evaluate and identify pathways for commercialization (see slide 8)
- Developed approach to conduct techno-economic analysis including: market segmentation, industry impact potentials (energy consumption/demand), and cost expectations based on savings

Key Issues:

- Difficult to build strong interest from commercialization partners without real world demo results
- Navigating intellectual property (IP) inquiries and issues expressed by developers and adopters
  - Different IP requirements among different CBEI technology developers

Distinctive Characteristics:

- Used an iterative approach to engage market partners as progress was made in technology development
- Developed a tool to help identify where an incentive might be necessary for control technologies to meet minimum payback periods

Preliminary Results of Market Analysis

Potential Market Partners for Commercialization & Deployment:

Synthesis of key findings and indicators of shared interests, approaches & focus

<table>
<tr><th></th><th>Small
(< 50 employees)</th><th>Medium
(< 250 employees)</th><th>Large
(> 250 employees)</th></tr>
<tr><td rowspan="2">BUSINESS MODEL</td><td colspan="3">Develop and distribute diagnostic and building performance software as a product, and provide engineering services.
Direct to Customer via National Accounts. Indirect distribution of products through Service Providers.</td></tr>
<tr><td>Provide expertise with a specific and proprietary product</td><td colspan="2">Diverse energy and engineering teams and product offerings, with multiple divisions and capabilities</td></tr>
<tr><td rowspan="4">R&D APPROACH</td><td colspan="3">R&D program budget increases with company size
Larger companies have a more structured R&D plan and need to evaluate how new technologies fit within their plan</td></tr>
<tr><td colspan="2">Agile internal decision-making, because centralized control of business</td><td>Greater lead time for internal decision-making (1-2 yrs in advance)</td></tr>
<tr><td colspan="3">Prefer and often require ‘real-world’ demonstrations, which may only take technology half way to commercialization.
Must evaluate technical compatibility with existing hardware and software platforms, and may require additional demonstrations to ensure compatibility</td></tr>
<tr><td colspan="2">Limited internal programming ability and cost to recode work may impact decision to commercialize</td><td>Robust software and programming abilities. Recoding less of a concern</td></tr>
<tr><td>MARKET ENGAGEMENT</td><td>Support needed to engage utilities for EE incentives and product eligibility</td><td colspan="2">Established relationships with utilities; do not require support to engage.</td></tr>
<tr><td>TECHNOLOGY TRANSFER</td><td>Licensing terms may have a greater impact on level of interest in technology, but may also be interested in exclusivity to provide differentiation</td><td colspan="2">Licensing terms are relevant but may not be as significant of a decision factor</td></tr>
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Preliminary Results of Market Analysis (cont.)

Key Takeaways

- Smaller software companies can be in a position to move faster to support commercialization but require support to develop strategy for market expansion
  - May require support to convince utilities to include control in a rebate program
- Need to engage larger companies early to find windows to fit within their more structured R&D plans. They do not require market engagement strategy support
  - Larger companies are working to make their development process more agile
- Completion of development through real-world demos can be only half of the development cycle to market

Market Sizing Tool Overview

- Designed analysis to evaluate building types and potential market size where control can achieve 2 year payback with and without a rebate
  - Rebate assumed to be $.10/kWh annual savings
- Segmented market with most recent available data
  - AEO 2014 - Total Commercial Energy Consumption
  - CBECS 2012 - Total Commercial Floor Space and number of buildings
  - CBECS 2003
    - Average % HVAC Demand (cooling only) by Principal Building Activity
    - % of Commercial Buildings with RTUs (46%)
    - % of Commercial Floor Space conditioned by RTUs (60%)
- Made the following assumptions
  - Buildings <1,000 SQFT do not have multiple RTUs
  - Energy savings of RTU coordinator = 15% of HVAC energy for cooling
  - Electricity cost = $.12/kWh
  - RTU Coordinator implementation cost is $0.10/SQFT

Characterized the Market by Building Use

Principal Building Activity	Number of Buildings (thousands)	Floor Space (million square feet)	2012 Annual Demand (quadrillion BTUs)	Energy Use Intensity (EUI) (thousand BTUs per square foot)	% HVAC Demand for Cooling	Pre retrofit HVAC Demand for Cooling (quadrillion BTUs)
Education	177	7,276	0.22	31	20%	0.045
Restaurant	75	720	0.12	160	7%	0.008
Food Service	171	1,073	0.12	116	13%	0.016
Out-patient Healthcare	65	1,023	0.04	38	15%	0.006
Lodging	71	3,443	0.14	41	10%	0.014
Retail	262	6,226	0.83	133	15%	0.123
Office	462	9,520	1.17	123	14%	0.166
Public Assembly	162	3,323	0.03	10	20%	0.007
Religious Worship	187	2,708	0.09	34	17%	0.015
Service	282	2,745	0.15	55	9%	0.014
Warehouse & Storage	362	7,739	0.08	10	6%	0.004
All SMSCB Buildings	**2,275**	**45,795**	**3.00**			**0.418**

Evaluated Building Types with Best Payback

- Target customers identified based on potential savings:
  - Savings projected post installation of RTU optimization control technology
  - Shows maximum implementation cost with and without an incentive applied where there will be a 2 year payback
- **Grey** – indicates building types where 2 year payback won't be achieved based on anticipated implementation cost of $.10/SQFT

			POST-RETROFIT SAVINGS ASSUMPTIONS		ECM PRODUCT COST LIMIT ESTIMATE	
			ESTIMATED SAVINGS (%)	ELECTRICITY COST PER kWh ($)	PAYBACK TERM (years)	PAYBACK TERMS (years)
INPUTS	→	→	**15%**	**$0.12**	**2**	**2**
Building Size Range	**Principal Building Activity**	**Pre retrofit HVAC demand** (quadrillion Btu)	**Post retrofit reduction HVAC** (quadrillion Btu)	**Annual Savings on Electric Bill HVAC** (millions $)	**Cost Limit per square foot ($)**	**Cost Limit per square foot ($) after rebate**
1,001 to 200,000 square feet	Education	**0.045**	0.007	**$238**	**$0.07**	**$0.09**
	Restaurant	**0.008**	0.001	**$40**	**$0.11**	**$0.16**
	Food Service	**0.016**	0.002	**$83**	**$0.16**	**$0.22**
	Out-patient Healthcare	**0.006**	0.001	**$30**	**$0.06**	**$0.08**
	Lodging	**0.014**	0.002	**$75**	**$0.04**	**$0.06**
	Retail	**0.123**	0.018	**$651**	**$0.21**	**$0.30**
	Office	**0.166**	0.025	**$877**	**$0.18**	**$0.26**
	Public Assembly	**0.007**	0.001	**$37**	**$0.02**	**$0.03**
	Religious Worship	**0.015**	0.002	**$81**	**$0.06**	**$0.09**
	Service	**0.014**	0.002	**$72**	**$0.05**	**$0.07**
	Warehouse & Storage	**0.004**	0.001	**$23**	**$0.01**	**$0.01**
TOTAL	**All SMSCB Buildings**	**0.418**	**0.063**	**$2,208**	**$0.10**	**$0.14**

Progress and Accomplishments

Lessons Learned:

- Entrepreneurial small companies are good candidates for early stage demonstrations and commercialization, but market impact will be smaller in the near term
- Larger companies can have larger market impact, but coordination requires more lead time to align with their R&D strategy

Accomplishments:

- Obtained interest from 11 companies (6 large, 2 medium, and 3 small) for both controls technologies, with commitments pending final outcomes of real-world demos. Several may be interested in conducting additional demos

Market Impact:

- RTU Coordinator could result in savings of 0.06 Quads if applied to all commercial buildings 1K to 200K square feet equaling approximately $2.2 billion in savings annually

Awards/Recognition: None

Project Integration and Collaboration

Project Integration: Project staff worked closely with technology developers and with potential commercialization partners to identify opportunities and barriers to commercialization

Partners, Subcontractors, and Collaborators: UTRC, Purdue, Drexel, Booz Allen Hamilton, and 11 potential commercialization partners

Communications: None to date

Next Steps and Future Plans

Next Steps and Future Plans:

- Complete market sizing for FDD for AHU
- Work with BTO to perform PTool analysis
- Continue to support deployment of CBEI solutions
- Continue to provide coordination between technology developers and commercialization partners
- Support BTO in developing deployment strategy for shading and window attachments

REFERENCE SLIDES

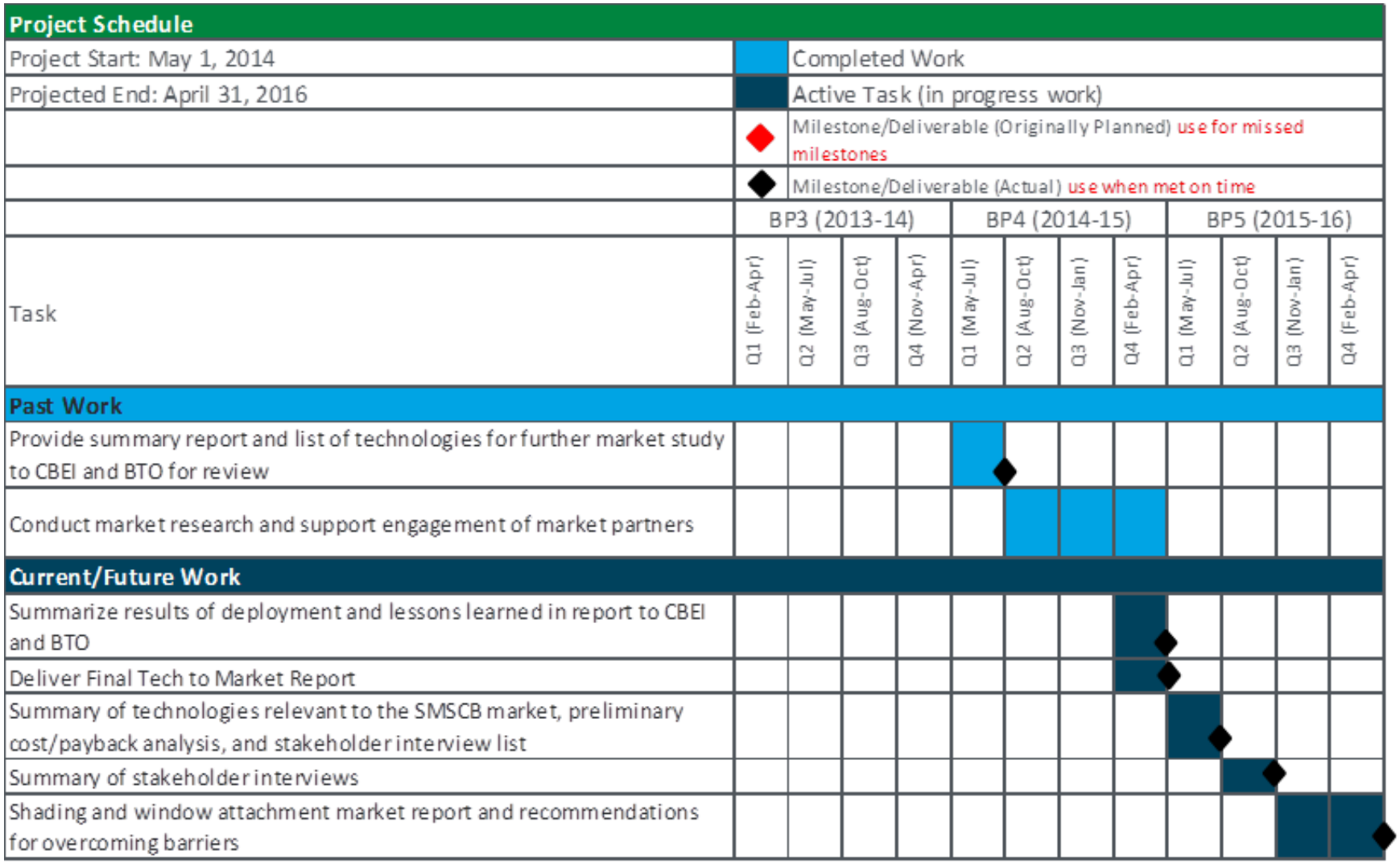
Project Budget

Project Budget: $318,700
Variances: None
Cost to Date: All budget by end of April
Additional Funding: None

Budget History					
CBEI BP3 (past) 2/1/2013 – 4/30/2014		CBEI BP4 (current) 5/1/2014 – 4/30/2015		CBEI BP5 (planned) 5/1/2015 – 4/30/2016	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$0	$0	$293,700	$25,000	$349,745	$25,292

CBEI – Consortium for Building Energy Innovation (formerly EEB Hub)
BP – Budget Period

Project Plan and Schedule



BP – Budget Period for Consortium for Building Energy Innovation (formerly EEB Hub)