Demonstrating & Deploying Integrated Retrofit Technologies & Solutions

2014 Building Technologies Office Peer Review

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

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Project Summary

Timeline:

Start date: 1 February 2012

Planned end date: 30 April 2015

Key Milestones

1. Q1 2012 initial testbed established
2. Q2-Q4 2012 additional test beds developed
3. Q2 2013 screened new pool of candidate buildings
4. Q4 2013 begin facilitated integrated projects

Budget:

Total DOE $ to date:	$1.74M
Total cost-share $ to date:	$ -
Total future DOE $:	$0.68M
Total future cost-share $:	$0.04M

Target Market/Audience:

Small- to medium-sized commercial building (SMSCB) owners, operators, building professionals, contractors, service providers, solution vendors & others in supply chain.

Key Partners:

The Pennsylvania State University	Bayer Material Sciences
University of Pennsylvania	Seven Group
Carnegie Mellon University	Purdue University
United Technologies Research Center	Owners of 28 demo buildings

Project Goal:

Provide robust capability, in real-world buildings, to demonstrate & deploy elements of affordable, broadly applicable, validated methods to support technology integration and 'deep' energy efficiency retrofit solutions into SMSCB's 5-10 year renovation / asset management plans.

Problem Statement and Challenges

Problem Statement:

This project seeks to demonstrate and validate:

- Projects in real SMSCBs undergoing actual owner-financed renovations.
- Savings from broadly-applicable packages of integrated retrofit technologies & energy efficiency measures (EEMs), and
- Methods for cost-effective evaluation and selection of EEMs for specific buildings and use-cases in any climate region.

Challenges:

- Low confidence that energy investments will perform in 'my' building.
- Laboratory validated technology is not well-situated for applications relevant to SMCSB Owner/Operators.
- Technical demonstrations and integration methods need to address the challenges and constraints of real world sites and projects.
- At SMSCB scale, adequate information to optimize retrofit decisions is often not available, or is unaffordable.
- SMSCB market actors resistant to up-front cost of the time that must be invested in integrated design efforts.

Target Market and Impact

Target Market and Audience:

- SMSCB Owners & Operators (O/Os)
- Architects, Engineers, Constructors (AECs) professionals
- Service providers, installers, vendors, manufacturers of energy efficiency products, systems, and services
- Corporate/Institutional Sustainability and Energy Managers

Project Impact:

- Near-term: Reduced energy use at demonstration sites.
- Intermediate-term: Uptake of methods and solutions by 'early adopters' in regional supply chain.
- Long-term: Uptake of methods and solutions by O/Os & supply chains nationally.

Approach

- Identify and engage regional market actors, with real world retrofit projects and decisions to make, who are willing to participate in Consortium projects.
- Match planned demonstration activities to available retrofits:
  - Building energy ‘controls’ and ‘system’ demonstrations;
  - Tools to shape efficient retrofit designs, and promote effective decision-making.
- Design & install adequate Measurement & Verification (M&V) to measure baseline energy use and future energy savings.
- Monitor retrofit installations, assess post-retrofit results, disseminate market communications.

Key Issues & Distinctive Characteristics

Key Issues:

- Because we are demonstrating in 'real' buildings, we don't control available staff, renovation budgets, decisions or schedules.
- Certain 'triggers' form the basis for many renovation/retrofit opportunities.
- Limited information is available for many SMSCBs.

Distinctive Characteristics:

- Installing appropriate M&V and establishing sub-metered baseline energy performance.
- Deploying a systems (integrated) approach to evaluate and select EEMs and effectively deliver the retrofit and/or a phased plan.
- Performing and reporting measured technical and economic analysis of retrofit.

Progress and Accomplishments

Discoveries:

- O/Os want a phased 'Asset Management Plan' on their shelf, to guide their renovation decision-making over the next 5-10 years.

Accomplishments:

- Established 28 Commercial Building test sites, including:
  - 11 M&V systems designed and installed which are capturing and serving detailed data sets from real operating buildings.
  - 3 test-beds demonstrating Advanced Controls and Diagnostics.
  - 13 projects demonstrating Building Energy Systems.
  - 10 projects demonstrating an Integrative Design Process for SMSCBs.
- Analyzed data sets from portfolios of buildings, demonstrating 'Continuous Efficiency Improvements' via analysis of utility bills, sub-metered data, energy models. Recommended changes in systems operations to decrease energy usage.

Market Impact

Market Impact:

- These demonstration projects are broadly representative of the age, systems and usage types of the commercial building stock in the Philadelphia region.
- Consortium Investigators at this conference are reporting impact of demonstrations of technologies and solutions.
- Enabled ~80 publications and presentations at National and International Conferences.
- Communication of solutions to market place via publications, presentations, and Consortium's relationships with regional SMSCB O/Os & service providers in supply chain.

Project Integration

Project Integration:

- This project enables collaboration between building owners, academia, and industry, in operating SMSCBs, through demonstration activities utilizing emerging and cutting-edge solutions and methods.

- Engagements with LBNL Energy Management Package and NETL Advanced RTU Campaign planned for later this year.

Project Collaboration and Communications

Partners, Subcontractors, and Collaborators:

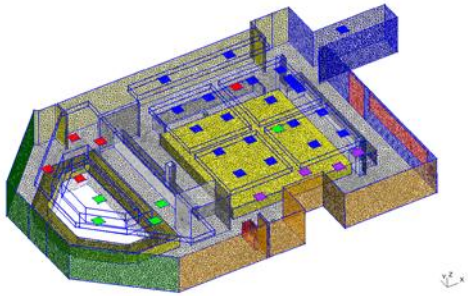
- 28 demonstration building Owner/Operators and their AEC teams

Communications:

- Consortium Investigators have published and presented ~80 publications on the impact of specific technology and solution demonstrations in journals, national and international conferences including: ASHRAE, AEE, AIA, International High-Performance Buildings Conference at Purdue, ASES, IEEE, ACWC, SimBuild, ACC, CLIMA, FutureBuild, Greenbuild.
- Presentations to regional trade organizations including BOMA, IFMA.

Next Steps

Project will continue:



- Collection and archiving of data sets from real operating buildings.
- Ongoing demonstrations of Advanced Controls Diagnostics in our test-beds: Model Predictive Control, Fault Detection & Diagnostics, wireless control of common spaces served by multiple RTUs, Virtual Sensors.

- Ongoing demonstrations of Integrated Envelope and System Solutions in our test-beds.
- Ongoing demonstrations of a streamlined Integrative Design Process designed for SMSCBs.

Future Plans

- Leverage portfolio of real-world demonstration projects and datasets as an asset for future Consortium and BTO deployments.
- Develop and broadcast ‘Best Practices’ and ‘Lessons Learned’ to the market place.
- Develop strategies that align SMSCB O/Os and service providers to routinely implement integrated retrofits.
- Consortium’s HQ building will be commissioned and occupied, and available as a versatile testbed in Q1 2015.

REFERENCE SLIDES

Project Budget

Project Budget: $2,416K multiyear effort
Variances: None
Cost to Date: $1736K
Additional Funding: None

Budget History ($K)							
FY2012 (past)		FY2013 (past)		FY2014 (current)		FY2015 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$724	-	$1,012	-	$680	$40	$0	-

Project Plan and Schedule

- Demonstration projects began in earnest in FY2012.
- Planned completion date 30 April 2015.