Project Impact Assessments – Building America FY14 Field Test Technical Support

2014 Building Technologies Office Peer Review

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

Lieko Earle, *lieko.earle@nrel.gov*
NREL

Project Summary

Timeline:

Start date: 10/1/2013

Planned end date: 9/30/2014

Key Milestones :

1. Launch Field Test Best Practices web-based facilitated discussion forum (6/30/2014)

2. Summary of Indoor Temperature Datasets (9/30/2014)

Budget:

Total DOE $ to date: $425k

Total future DOE $: TBD

Target Market/Audience:

NREL's efforts under this task are focused on enabling the success of BA Teams and National Labs. The project ultimately targets all stakeholders in the residential building market chain.

Key Partners:

ARIES	CARB	LBL
ARBI	IBACOS	ORNL
BARA	PHI	PNNL
BA-PIRC	NorthernSTAR	
BSC	PARR	

Project Goal:

To provide extensive, hands-on, technical support to BA teams in the areas of

- experiment design,
- provision of research-grade measurement hardware,
- energy modeling, and
- analysis

to ensure that all BA field tests result in high-impact findings that push builders and homeowners to higher levels of savings.

Project Impact Assessments – Building America FY14 Field Test Technical Support :

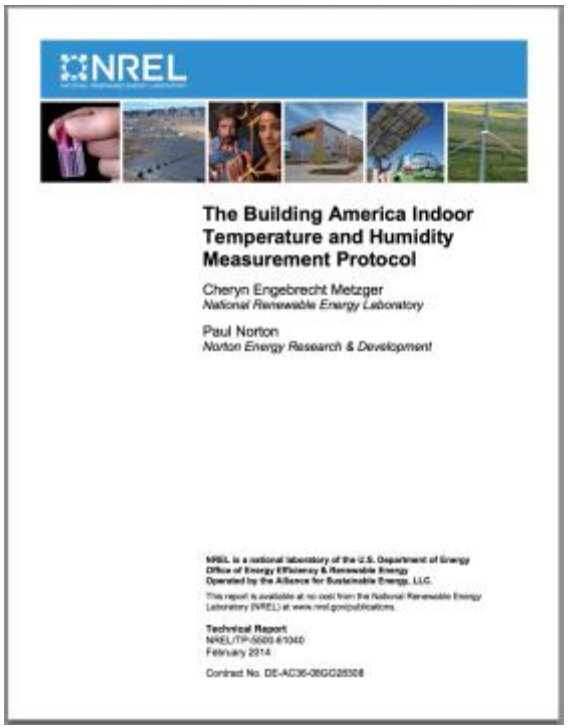
There are numerous parallel activities in this project. The first several slides give a snapshot of the variety of ongoing activities in:

- Developing Field Test Tools & Techniques
- Partnering with BA Teams on Field Tests
- Providing Expert Technical Assistance

Developing Field Test Tools & Techniques

Indoor Temperature Datasets

- Temperature assumptions made in simulation inputs have a large impact on predicted energy use.
  - How do people use setpoints?
  - How does a centrally located setpoint relate to real temperatures around a house?
- Dearth of data on real operating temperatures in homes.



- In FY13 NREL developed BA protocol for indoor T&RH collection to ensure consistency, quality.
- Over 100 homes have had this protocol implemented during field tests, working with IBACOS, BSC, CARB, FSEC, BARA.
- FY14 efforts to implement this protocol in BA field test opportunities will result in datasets from over 150 residences. Results will be archived in BAFDR, and will substantially improve the accuracy of building simulation results.

Developing Field Test Tools & Techniques

HPWH Field Monitoring Protocol

- In FY13 NREL published a field m
  HPWH.
- The installation and data collection m
  validated by monitoring a local NRELian's H
  his home over the course of a full year.
- The protocol is a how-to guide, giving detailed recommendations on planning, instrumentation, and analysis for evaluating the field performance of HPWH.

Partnering with Teams on Field Monitoring & Experiments

Dehumidification Study in New Orleans with BSC

- Unique opportunity allowed comparison of similar homes with and without supplemental dehumidification.
- NREL provided equipment & expertise to collect and analyze datasets from 10 homes over a one-year study.
- Results provided new insights into complex issue of residential dehumidification in low-load homes.

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

Partnering with Teams on Field Monitoring & Experiments

Manufactured Lab Homes in Alabama with ARIES

- Installing detailed instrumentation in 3 side-by-side manufactured homes for a one-year study.
- Evaluating options for new building envelope and HVAC strategies for manufactured homes.

Partnering with Teams on Field Monitoring & Experiments

Moisture Capacitance study in Cocoa, FL with FSEC

- A new technique for measuring whole-house moisture buffering was evaluated with tests on an FSEC lab home.
- NREL developed the technique and provided equipment, while FSEC coordinated furnishings; the house started empty and finished fully-furnished.
- Data were used to develop inputs for moisture buffering models, important for studying potential humidity problems.

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

Providing Expert Technical Assistance

Field Test Best Practices Development

- Difficult to find good general guidelines & examples of good field test plans
- No easily-accessible central repository for best practices knowledge
- Field tests were taking longer and costing more $$ than initially estimated
- Difficult to find information on instrumentation options

- Publicly available central repository of (including 'expert folklore') → efficiency
- Guidelines and examples of well-designed tests → consistency
- Dynamic website: search, sort, assemble, update → convenience
- Distributed content generation → input from content experts

Continue to build on what we already know

Reduce Cost and Accelerate Speed, Scale, and Quality

Purpose and Objectives

Problem Statement:

- Success of BA program ultimately lies with the Teams' abilities to work with the building industry and continually push them to higher levels of energy efficiency.
- NREL's support is required to ensure consistency across researchers and datasets resulting from different projects, so that findings are comparable, making it possible to interpret results in broader context for maximum impact.

Target Market and Audience: BA Teams, residential building industry

Impact of Project:

- Field testing of building components and systems provides a crucial link in the pipeline that funnels DOE's world-class research to the residential building industry.
- These tests are a vital component of our QA & QC: real-world measurements of high performance systems provide objective, scientifically rigorous assessments of technology readiness and cost-effectiveness before they are recommended for wide adoption. The result is reduced risk for all stakeholders in the market chain, leading to accelerated adoption of the best energy-efficient building practices.

Approach

Approach:

- Provide ongoing hands-on technical support for BA Team field tests in:
  - experiment design,
  - provision of research-grade measurement hardware,
  - energy modeling, and
  - rigorous analysis

  to ensure that all BA field tests result in high-impact findings. This support enables BA teams to focus on their best work of communicating to builders the value and feasibility of high-performance buildings and energy-efficient building practices.
- Collaborate with BA Teams, National Labs, and other industry partners in the areas of:
  - Data collection (to be archived in BAFDR) & analysis to inform models and validate approaches to efficiencies, and
  - Organization and dissemination of knowledge from Building America's history of high-performance building field tests, including test methods, research findings, and lessons learned.

Approach (cont'd)

Key Issues: BA teams have intimate knowledge of current building practices and marketplace barriers to energy efficiency, and they have key relationships with building industry leaders. NREL engineers have deep expertise in designing and executing field tests using state-of-the-art measurement tools and techniques. BA program success requires high level of coordination between these two key capabilities.

Distinctive Characteristics:

- NREL engages early in the field test planning process by reviewing all test plans and working hand-in-hand with Teams to iterate on experimental design. This results in greater flexibility in project planning.
- NREL coordinates field test opportunities to maximize usefulness of each test site opportunity. For example, the incremental cost to adding temperature data collection to an existing field test is small compared to the resulting benefits.
- Standardization of data collection and formatting will accelerate efforts to build up BADFR archive.
- *Field Test Best Practices* site takes a unique approach to guidance documentation, by providing a dynamic web medium where users can easily contribute their knowledge and expertise.

Progress and Accomplishments

Lessons Learned:

In past years there have been field tests where

- Research questions were not well established before the experiment began,
- Test methods did not make use of best available equipment and practices, or
- Lack of communication resulted in reinventing of many wheels….

These experiences led us to engage much earlier and more proactively at the onset of each project.

Accomplishments:

- Over FY13 and FY14, NREL has provided review, guidance, and/or direct field support in 80+ BA Team field test projects.
- 30+ technical reports, measure guidelines, and case studies published thus far in FY14.
- Indoor temperature datasets have been collected and analyzed in over 100 homes. Demonstrated significant variations within homes of a given area and between areas.
- The *Field Test Best Practices* site has had 7600 page views thus far in FY14.

Progress and Accomplishments

Market Impact:

- More cost-efficient field tests will save BA program estimated 30% annually.
- Using best practices will reduce costs and improve the impact of measurement and verification, which is critical for establishing the efficacy of new energy-efficient technologies and for reducing market barriers. Our field tests ultimately lower the financial and health risks for builders, contractors, and homeowners.

Awards/Recognition:

No awards, but refer to last slide for testimonials from BA Team collaborators

Project Integration and Collaboration

Project Integration:

- NREL facilitates coordination across Team and Labs.
- NREL works with BA Teams, who work directly with building industry stakeholders.

Partners, Subcontractors, and Collaborators:

- BA Teams
- LBL, PNNL, ORNL
- C.E.Hancock and his team
- Energy Center of Wisconsin & Dan Cautley's team

Communications:

- 20+ presentations to outside stakeholders each year
- 80 -100 research publications each year

Next Steps and Future Plans

Next Steps and Future Plans:

- Facilitated forum development underway for FTBP website. Content is continually being updated and we are recruiting contributors.
- Further analysis efforts on indoor temperatures (e.g. how should temperature distribution be modeled given a single setpoint?)
- Continue to collaborate with Teams & Labs on high impact field projects.

Summary

Project Relevance: Validation of real-world performance of energy-efficiency measures reduces risks for all stakeholders in market chain. NREL's technical support ensures high quality, consistent, and cost-effective field tests.

Approach: High degree of coordination and collaboration with Teams and Labs, Continually updated guidance documents and technical resources

Impact:

- Cost-efficient field tests save BA program estimated 30% annually.
- High-impact results are disseminated via 80-100 publications and 20+ presentations annually.
- Field test opportunities are maximally leveraged to accelerate addition of datasets into BAFDR to inform and improve energy models.

Testimonials

We appreciate that NREL staff is very accessible, always responsive to our technical needs, provides great guidance on project priorities and approach, and helps us interpret DOE priorities.
– David Springer, Davis Energy Group/ ARBI Team

NREL has provided technical field support to several of our projects that has made it possible for us to collect data to inform our research. The work in New Orleans done with the support of NREL will mean that we have collected valuable information about the operation of several types of supplemental dehumidification systems as well as general information about the range of relative humidity reading seen in high performance homes. The work in Massachusetts done with the support of NREL will mean that we have collected valuable information about the temperatures and relative humidities seen in high performance homes with mini-splits.
– Betsy Petit, Building Science Corporation

Much of the research undertaken in Building America is expanding on knowledge and pushing the boundaries of what is possible to create new knowledge. As such NREL provides IBACOS with an "on call" peer to provide feedback on ideas and strategies for executing research. Specific areas NREL is useful in the BA program for IBACOS include:

- *Review and comment on test plans*
- *Technical support for advanced modeling such as TRNSYS and EnergyPlus*
- *Review and support for monitoring the performance of houses (both design of experiment, physical equipment, and actual installation)*
- *Providing a coordinating role amongst BA teams*
- *Managing the programmatic nuances and minutia (such as the BA benchmark, peer reviews, or BAFDR) that help to systematize and standardize the research baseline and results*
- *A deep knowledge base upon which IBACOS can draw upon as needed based on specific research projects*
- *Collaborative research areas such as lab testing of space conditioning equipment and supply outlets*

– Duncan Prahl, IBACOS

REFERENCE SLIDES

Project Budget

Project Budget: $ 425k
Variances: None
Cost to Date: $ 200k
Additional Funding: None

Budget History					
FY2013 (past)		FY2014 (current)		FY2015 – TBD (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
		$ 425k	$ 0		

Project Plan and Schedule

No missed milestones or deliverables. All work is progressing according to schedule.

Go/no-go decision points – N/A