



2013 Building America Research Planning Meeting Summary

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Confluence Communications

**NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy
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Technical Report
NREL/TP-5500-61006
February 2014

Contract No. DE-AC36-08GO28308

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Prepared under Task No. BE13.0542

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Executive Summary

The *Building America Research Planning Meeting* was held October 28-30, 2013, in Washington, D.C. This meeting provides one opportunity each year for the research teams, national laboratories and Department of Energy (DOE) managers to meet in person to share the most pertinent information and collaboration updates. This report documents the presentations, highlights key program updates, and outlines next steps for the program.

Each of the ten Building America teams and four participating national laboratories presented their key or “capstone innovation” projects for the current term of the Building America program (2010-2014). The following list provides highlights of the key projects that were covered by each team and lab.

TEAMS:

Alliance for Residential Building Innovation (ARBI)

- Development of six measure guidelines in mechanical and water heating systems
- Successes and lessons learned from the California retrofit transaction program.

Advanced Residential Integrated Energy Solutions (ARIES)

- Advanced envelope designs that could change the factory-built home market
- Efficiency strategies for existing systems in multifamily housing market.

Building America Partnership for Improved Residential Construction (BA-PIRC)

- Success in 30% new construction and the realistic phased deep retrofit approach
- Hot water heater laboratory-produced rankings of 15 advanced water heating systems.

Building America Research Alliance (BARA)

- High impact, market transformation using innovation-specific stakeholders/programs
- Large-scale media engagement and outreach for key Building America activities and research results.

Building Science Corporation (BSC)

- Code compliant guidance for innovative high R-value wall and roof strategies
- Evaluation of the unique National Grid deep energy retrofit program that includes 42 homes.

Consortium for Advanced Residential Building (CARB)

- Cost-effective strategies for mechanical ventilation, air sealing/compartmentalization, and estimating air leakage to outside using unguarded blower door test results for multifamily dwellings
- Encapsulated and buried duct strategy to minimize thermal losses through ductwork in unconditioned spaces for new and existing homes.

IBACOS

- Low-load HVAC modeling and experimentation in test homes
- Innovative HVAC strategies for Challenge Homes.

NorthernSTAR

- Innovation in excavation-less foundation insulation for retrofits
- Integrated combi systems for retrofit in low-load homes.

Partnership for Advanced Residential Retrofit (PARR)

- Strategy for categorizing archetypes for retrofit projects in a given area
- Focus on urban multifamily retrofits including envelope and central systems.

Partnership for Home Innovation (PHI)

- High performance wall research, including the innovative extended plate and beam system
- The Challenge Home Student Design Competition.

NATIONAL LABORATORIES:

Lawrence Berkeley National Laboratory (LBNL)

- A new air tightness database that aggregates information and estimates impact of better airtightness practices
- Concrete guidance on kitchen ventilation effectiveness through extensive testing.

National Renewable Energy Laboratory (NREL)

- Data-sharing standard for data aggregation for the entire residential community
- Window air conditioner installation guidance that could save 5%-10% on air conditioning energy.

Oak Ridge National Laboratory (ORNL)

- Studies on variable capacity air handler systems
- Characterization of major leak paths in walls that prioritize air sealing efforts.

Pacific Northwest National Laboratory (PNNL)

- BASC that successfully links Building America to the building industry through the Building America Solution Center (BASC) and corresponding case studies
- Collaboration with ORNL, northwest and Florida organizations to save 24%-63% on 19 retrofit metering projects.

DOE managers provided a high-level perspective during the meeting, summarizing four key messages:

- The biggest upcoming challenges for the energy efficiency industry will be competing with low prices on photovoltaics and learning how to apply proven new construction solutions to existing homes.
- A larger emphasis on deployment gaps has shifted Building America FY14 funding to be higher in areas of educating professionals, transaction processes, and codes and standards initiatives.

- The Housing Innovation Awards initiative and the Challenge Home Program have been a huge success with a lot of uptake and media attention.
- An important expert meeting will be held in FY14 to help the program/industry brainstorm words, phrases, and communication approaches that best “sell” energy efficiency and associated technologies and systems.

This report documents the most important outcomes of each of the six sessions that took place at this internal meeting. For more detailed information, view the presentations at the Building America website at: www.buildingamerica.gov.

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Logistics

The *Building America Research Planning Meeting* took place over three days (October 28-30, 2013) in the Washington, D.C. office of the National Renewable Energy Laboratory (NREL). Six main topics were covered over the course of the three-day meeting, including:

- 1) Building America Solution Center (BASC) Process Taxonomy
- 2) Building Science Education Task Force Update
- 3) Codes and Standards Initiative Task Force Update
- 4) DOE Update on Priorities
- 5) Team and Lab Capstone Innovations
- 6) Discussion: Proving that the Building America research teams have reached 30% (above the Building America Benchmark) energy efficiency performance goals for the program.

The meeting attendees and associated organizations are listed in the table below:

Andre Desjarlais – ORNL	Joe Lstiburek - BSC
Ari Rapport – IBACOS	Joe Wiehagen – PHI
Betsy Pettit – BSC	Jordan Dentz – ARIES
Cheryn Metzger – NREL	Larry Brand – PARR
Craig Savage – BARA	Mark Berman – ARBI
Dane Christensen – NREL	Mary Werner – NREL
Danny Parker – BA-PIRC	Max Sherman – LBNL
Darren Harris – BARA	Pam Cole – PNNL
David Roberts – NREL	Pat Huelman – NorthernSTAR
Deane Evans – BARA	Patrick Phelan – DOE
Dianne Griffiths – CARB	Roderick Jackson – ORNL
Duncan Prah – IBACOS	Sam Rashkin – DOE
Emanuel Levy – ARIES	Srikanth Puttagunta – CARB
Eric Martin – BA-PIRC	Stacey Rothgeb – NREL
Eric Werling – DOE	Stacy Hunt – BARA
Garrett Mosiman - NorthernSTAR	Sydney Roberts – PHI
Glenn Cottrell – IBACOS	Theresa Gilbride – PNNL
Hugh Henderson – ARIES	Tom Kenney – PHI
Iain Walker – LBNL	Vladimir Kochkin – PHI
Jeremy Williams – DOE	William Zoeller - CARB

Objective

The objective of the *Building America Research Planning Meeting* was to gather all the internal teams, national laboratories and Department of Energy (DOE) managers together to discuss recent important information and decisions. This meeting is a cost-effective way to provide updates to the Building America participants on key program activities, priorities, results, and collaboration opportunities. The meeting concluded with a discussion on Building America's proven performance at 30% above the Building America Benchmark.

Agenda

Day One: Monday, October 28, 2013

- 12:00 – 1:00 pm BASC Process Taxonomy
- 1:00 – 3:00 pm Building Science Education (BSE) Task Force Working Group
- 3:15 – 5:15 pm Codes and Standards Innovation (CSI) Team Working Group

Day Two: Tuesday, October 29, 2013

- 8:30 – 9:30 am: DOE Updates and Priorities
- 9:30 – 10:00 am: NorthernSTAR Building America Partnership (NorthernSTAR)
- 10:00 – 10:30 am: Alliance for Residential Building Innovation (ARBI)
- 10:30 – 10:45 am: Break
- 10:45 – 11:15 am: Partnership for Home Innovation (PHI)
- 11:15 – 11:45 am: Building America Partnership for Improved Residential Construction (BA-PIRC)
- 11:45 am – 12:15 pm: Partnership for Advanced Residential Retrofit (PARR)
- 12:15 – 1:45 pm: Lunch
- 1:45 – 2:15 pm: Consortium for Advanced Residential Buildings (CARB)
- 2:15 – 2:45 pm: IBACOS
- 2:45 – 3:15 pm: Building America Research Alliance (BARA)
- 3:15 – 3:30 pm: Break
- 3:30 – 4:00 pm: Advanced Residential Integrated Energy Solutions (ARIES)
- 4:00 – 4:30 pm: Building Science Corporation (BSC)
- 4:30 – 5:00 pm: Wrap-Up

Day Three: Wednesday, October 30, 2013

- 9:00 – 9:30am: Team Technical Management, NREL
- 9:30 – 10:00am: NREL
- 10:00 – 10:30am: PNNL
- 10:30 – 10:45am: Break
- 10:45 – 11:15am: ORNL
- 11:15 – 11:45am: LBNL
- 11:45am – 12:15pm: Introduction to “Proven Performance” Goals and Objectives
- 12:15 – 1:45pm: Lunch
- 1:45 – 4:30pm: Facilitated Discussion – Proven Performance
- 4:30 – 5:00pm: Wrap-Up

On Thursday, October 31, 2013, the DOE Emerging Technologies and Building America Programs held a collaborative workshop. The notes and results from this workshop will be captured in an addendum to the forthcoming *Emerging Technologies Roadmap for Building Enclosures*.

Agenda Summaries

1) BASC Process Taxonomy

This session was led by Duncan Prah (IBACOS), who provided an overview of IBACOS' proposed structure of process-related content, and asked for feedback from the group. The response was that the highest priority needs for process taxonomy were related to the DOE Challenge Home implementation. The following list outlines the primary outcome from this session:

- The BASC tab structure and Challenge Home taxonomy will remain unchanged. This will be the most consistent and cost-effective approach.
- The BASC can reference Building America content that already does or will exist. This is particularly true within the "Ensuring Success" tab that continually references the more detailed QA/QC issues builders need to address as part of the broader categories in the taxonomy.

The action item for IBACOS is to provide a suggested structure to DOE for future consideration.

2) Building Science Education Task Force Meeting

In this session, Sam Rashkin (DOE), Pat Huelman (NorthernSTAR), and Stacy Hunt (Confluence) provided updates about the Building Science Education (BSE) Task Force. They summarized activities to date for the task force, and presented the upcoming draft *Matrix of Building Science Classifications, Core Competencies, and Proficiency Levels*. The intent of this session was to gain feedback from Building America internal team members on the approach and direction of the BSE Task Force.

The BSE Task Force has selected two items from the BSE Roadmap (produced in November 2012), where Building America can have the largest impact:

- Help organize and guide the Challenge Home Student Design Competition
- Develop a *Matrix of Building Science Classifications, Core Competencies, and Proficiency Levels* to inform a variety of workforce classifications and requirements.

Key feedback from the audience included:

- The "Bloom's Taxonomy" in the matrix is providing a good overarching construct for the proficiency levels (or depth of knowledge and/or skill).
- One possible "hole" is a better representation of the design and construction processes.

- The program will need to engage other groups to assist in developing the proficiency levels and resource inventories for various key audiences.

The action items for the BSE Task Force are to:

- Come to agreement on the definition of “building science” and to further develop and vet the draft matrix with industry.
- Evaluate proficiency levels from other professions for continuity.
- Work to understand the dynamics of accreditation bodies and licensing programs to best engage these organizations as guidelines are developed.

3) Codes and Standards Innovation Task Force Meeting

The Building America Codes and Standards Innovation (CSI) Task Force held an update and planning meeting, led by Pam Cole (PNNL). The intent of the meeting was to provide a recap of activities that have taken place since the first meeting held in February 2013, an overview of the CSI Roadmap, and an open discussion regarding the *CSI Guidance Document on Identifying and Overcoming Code and Standard Barriers*.

Four of the main messages from the meeting were:

- The CSI Task Force needs to maintain and track a refined list of Building America issues that are impacted by codes and standards (survey the teams to provide content).
- Existing content demonstrating success with installation of an innovation facing a codes and standards barrier needs to be posted for others to access (e.g. BASC)
- Codes and standards barriers should be identified by the teams in content that they submit to the BASC. If the team has found installation techniques that avoid the barrier and that have been successfully accepted by code officials in the field, these should be identified and included in the measure guide.
- Most teams identified roughly one “real” code barrier per year.

The action items for the CSI Task Force are to:

- Send reminder to teams and obtain feedback on the CSI Roadmap and Guidance Document by December 31, 2013.
- Send reminder to teams and update the table of identified issues received from the teams..
- Maintain a list of codes and standards barriers and any progress to overcome them.
- Determine appropriate way to populate BASC with content related to codes and standards.

4) DOE Program Updates

DOE representatives kicked off the meeting on October 29 with presentations on DOE priorities.

Eric Werling, DOE

Eric Werling, DOE, provided an overview of DOE's current focus for residential buildings, and Building America. In his presentation, Werling provided context for Building America's current priorities, which focus on providing a Hub of Innovation for American Housing through Building America. DOE's work has recently turned to an emphasis on the "Race to Zero Energy Homes," focused on energy use reduction and economic development. The concentration is on boosting innovation and market uptake for technology that improves energy performance. Energy codes, he pointed out, have caught up with the accelerating pace of technological change. He stressed that the program now has a strong basis and compelling story about innovation that is taking place in the housing market. Consumers are now demanding energy efficient homes and recognizing the value, as seen in the results to buyer opinion surveys conducted by the National Association of Home Builders. This shows a big change from just 5-6 years ago. Werling summarized research progress in 2013, where Building America conducted a strategic rebalancing of Building America RD&D (research portfolio). In addition, Building America launched Challenge Home, and the BASC, along with 2013 Top Innovations.

Sam Rashkin, DOE

Sam Rashkin, DOE, provided an overview and update of key Building America initiatives, including:

- Top Innovations for 2013, presented at the 2013 Solar Decathlon, with 10 winners—seven Building America teams and three national laboratories. More information on these awards can be found online at http://www1.eere.energy.gov/buildings/residential/ba_innovations.html
- Housing Innovation Awards: In this inaugural competition in FY13, Challenge Home garnered 23 winners and a great response for applicants. Nineteen of the winners were new homebuilders and four were remodeling contractors.
- The Excellence in Building Science Education Award was presented to Pat Huelman of the NorthernSTAR research team, who "has been recognized for his 'systems approach' to improving overall housing performance, with a focus on energy efficiency, long-term durability, indoor air quality, and environmental responsibility."
- Building Science Education (BSE), initiatives with two key areas:
 - BSE Task Force, with a focus on developing guidelines for building science education classifications, core competencies, and proficiency levels.
 - Challenge Home Student Design Competition, focused on reaching college students to embrace innovations.

5) Building America Capstone Innovations

Each of the ten Building America teams and four participating national laboratories were asked to present their key or "capstone innovation" projects for the current term of the Building

America Program (2010-2014). The following provides key points of the projects that were covered by each team and national laboratory.

NorthernSTAR

Integrated Space and Water Heating (Combi) Systems for Retrofit

- Innovation Potential
- Research Results
 - Laboratory testing results
 - Field study results

Foundation Retrofit for Cold Climates

- Fundamental hygrothermal testing at the Cloquet Residential Research Facility
 - Research approach
 - Preliminary results
- Quick review of potential retrofit for concrete masonry
- Sneak peek of “excavationless” demonstration.

ARBI

Retrofit – Process and Transactions

- Project results
- Ongoing and upcoming work

Retrofit - Technical

- Lessons learned from deep retrofits
- HVAC Maintenance

New Construction

- Zero Net Energy Ready Homes & Communities
- Innovative Technologies & Strategies
- Water Heating Research

Impacts and Ties to Market

PHI

- High performance walls (NextGen advanced framing, foam sheathing, moisture performance, extended plate and beam system)
- Quality management systems for high performance homes (Hot Spots Tool, QMS primer for high performance homes, economics of quality)
- Affordable packages for production home builders (Winchester Homes, K-Hovnanian Homes, Nexus EnergyHomes)
- Envelope retrofit solutions (Greenbelt pilot project, retrofit wall panels)
- Builder guidance and tools (TechSpecs on closed crawls and whole-house ventilation, prescriptive path for ICC-700 (NGBS), PEX Plumbing Guide, LCCTC Vocational School, Wall Construction Guide)
- Challenge Home Student Design Competition (TO 4-5)

BA-PIRC

- 30% savings - new construction (cost neutrality, sales data, challenge home success/challenges)
 - 2014 projects – business metrics and duct encapsulation
- 30% savings - retrofit (community-scale results, local government policy implementation)
 - 2014 project – market transformation project – the Retrofit Challenge
- Space conditioning research – low load HVAC (SEER 22) and ventilation
 - 2014 projects – mini-split RH control, temperature based ventilation controller
- Hot water research – performance rankings of 15 advanced water heating systems
 - 2014 project - continuation
- Phased deep retrofits – detailed pre- and post-retrofit end use monitoring for shallow and deep retrofits
 - 2014 project – adding to the savings with additional retrofits

PARR

Capstone Innovations

- Urban multifamily building retrofit opportunities – steam systems, thermal envelope, hydronic systems
- Archetypes for single family residential retrofit measure packages
- Natural gas furnace performance Improvements in the lab and in the field

PARR Plan for TO5

- Reducing the cost of retrofit through low-cost radon mitigation
- Combustion safety measure guideline and field data collection

CARB

Buried and Encapsulated Ducts

- Allowed by code, Measure Guideline published, and early adoption underway
- Continue to refine and support greater market adoption

Hygrothermal Performance of High-R Walls in Cold Climates

- Simulation of moisture dynamics of double-stub walls
- Monitoring and occupied conditions data collection

Multifamily Building Research

- Source control mechanical ventilation
- Whole-unit mechanical ventilation
- Compartmentalization
- In-unit mechanical equipment solutions
- Envelope leakage model

IBACOS

Capstone Innovations

- HVAC research in low load homes: Modeling, unoccupied and occupied test house results
- Quality management

IBACOS Plan for TO5

- Conclusion of HVAC research in multiple climate zones
- Challenge Home - builder support and innovative HVAC strategies
- Conclusion of Codes work on:
 - Code language related to duct system performance criteria and interaction with HVAC system operation (fire spread / smoke developed / fire promulgation) AKA “Plastic Ducts”
 - Air sealing fire separation assemblies

BARA

Capstone Innovations

- Market transformation using innovation-specific, stakeholder-driven outreach programs: heat pump water heater (utility-incentive), Vegas (Neighborhood Stabilization Program) and ARIES (Public Housing Authority)
- Changing the transaction process by driving change in stakeholder practices: Auto-population of energy efficiency valuation information in the appraisal process (AI and RESNET)
- Creating industry and consumer awareness: Media engagement and outreach to drive interest in Building America initiatives and research results (BASC launch, website traffic and downloads, placed publications and promotions, award promotions)

BARA Plan for TO5

- Changing the transaction process by driving change in stakeholder practices: Home inspection processes focused on informing (researchers and consumers) and educating (inspectors and consumers) about energy efficiency
- Creating industry awareness: Developing strategies to inform code officials about Building America initiatives and research results

ARIES

Introduction

- ARIES Team Operating Framework
 - Affordable housing bias
 - Articulating a path to market transformation
 - Managing through collaboration; placing the onus on key stakeholders
- Who is ARIES – team members and industry partners
- ARIES emphasis on affordable defines market segments and housing types
 - Low-rise multifamily retrofit
 - Housing communities
 - Factory-built housing, manufactured and modular

Improving Performance of Multifamily Buildings

- Overheating in hot water and steam heated multifamily buildings
- Hydronic heating retrofits for low-rise multifamily buildings
- Thermostatic radiator valve evaluation
- Control strategies to reduce energy consumption of central domestic hot water systems
- Disaggregating hot water use and predicting distribution losses in five test homes
- Air distribution retrofit strategies in affordable housing

Improving Performance of Factory Built Homes

- Advanced envelopes for manufactured homes
- ARIES directions for TO5 and beyond
 - Manufactured housing
 - Selected other projects

BSC

- High R-Value Walls
 - Cladding attachment through continuous exterior insulation
 - Hybrid walls – City of Wyandotte, MI
- High R-Value Roofs
 - Guidelines for spray foam under roof decks
 - Guidelines for dense pack roof assemblies
- Zero Energy Communities
 - Transformations Builders – Devens, MA
 - Transformations Builders – Easthampton, MA
- Whole House Retrofits
 - National Grid Deep Energy Retrofit Program – 42 Homes
 - BASC document - High R-value Retrofit for Roofs
 - Window retrofit packages
 - Research and guidance on interior retrofit of masonry structures

NREL

- Data-sharing standard provides unbounded potential for data aggregation for the entire residential community
- Can save 5%-10% on air conditioning energy by implementing the NREL window air conditioner guidance

PNNL

- Successfully linked Building America to the industry through the BASC and various case studies
- Worked with ORNL, northwest and Florida organizations to save 24%-63% on 19 retrofit metering projects

ORNL

- Studies on variable capacity air handler systems provide broad benefits
- Characterization of major leak paths in walls helps prioritize air sealing efforts

LBNL

- Developed the air tightness database to aggregate information and estimated impact of better airtightness practices
- Extensive testing has led to concrete guidance on kitchen ventilation effectiveness

6) Proving Program Successes at 30%

The Proving Program Success at 30% session was led by Cheryn Metzger (NREL). The intent of the session was to discuss how Building America would prove that the program reached an acceptable level of success at 30% above the Building America Benchmark (consistent with the 2009 IECC).

The facilitated discussions engaged DOE, Building America teams, and national laboratories, and provided a path forward for documenting proven performance in 2014 and beyond. The relevant conclusions were as follows:

- The baseline for 30% savings should be the Building America B10 Benchmark which uses the 2009 IECC and 2010 appliance standards along with referenced occupancy assumptions. This baseline is consistent with the majority of the new construction projects in the United States. It is also the requirement for states to get DOE funding.
- Cost effectiveness can be defined by “market acceptable.” That is to say that if a package of measures has been used by a builder and sold in a reasonable timeframe, then the whole-house package must be cost effective.
- The most representative and politically neutral way to show proven performance in each climate zone is to use the case studies associated with each Building America project.
- The packages associated with the most cost-effective Building America projects are meeting or exceeding Challenge Home, which means that the Challenge Home program is a perfect market solution for the program to promote and another way to show that the program has reached its goal of 30% energy savings above the B10 Benchmark (consistent with the 2009 IECC)

The action items for the Communications team are:

- Gather relevant Challenge Home case studies throughout the next year.
- Determine the best outreach partners to help the program show proven performance at 30%
- Submit proposals for Top Innovations in FY14.

Conclusions

The meeting was a great balance of updates, prioritization, and collaboration. The action items from the meeting were as follows:

Action Items

The action item for IBACOS is to:

- Provide a suggested structure to DOE for future consideration.

The action items for the BSE Task Force are to:

- Come to agreement on the definition of “building science” and to further develop and vet the draft Matrix with industry
- Evaluate proficiency levels from other professions for continuity
- Work to understand the dynamics of accreditation bodies and licensing programs to best engage these organizations as guidelines are developed.

The action items for the CSI Task Force are to:

- Send reminder to teams and obtain feedback on the CSI Roadmap and Guidance Document by November 29, 2013
- Send reminder to teams and update the table of identified issues received from the teams.
- Maintain a list of codes and standards barriers and any progress to overcome them
- Determine appropriate way to populate BASC with codes and standards content.

The action items for all teams are to:

- Consider how Building America interacts and collaborates with other DOE programs such as Codes and Emerging Technologies
- Consider how the program may be improving through the new Funding Opportunity Announcement.

The action items for the Communications Team are to:

- Gather relevant Challenge Home case studies throughout the next year
- Determine the best outreach partners to help the program show proven performance at 30%
- Submit proposal for top innovations in FY14.

Parking Lot

Throughout the meeting, when side conversations were getting too lengthy, comments, suggestions and discussion topics were put in a “parking lot” as input for the next internal meeting. Those topics are included as follows:

- “Single measure” issue: This is not the best terminology to be used for even internal communication, as it creates the wrong impression about systems integration and whole-house approaches.
 - Incremental integration?
 - Component measure?
- How to report on testing that addresses standards
- Definition of multifamily?
- Why do deep energy retrofits?
 - No dollar savings
 - Difference between energy value and non-energy value

- Delayed value
 - Utility incentives
- Meeting series (public stakeholder meeting)
- Building America Field Data Repository
 - Technical issues/loading
 - How public is the data? Proprietary information?
- Codes and Standards
 - Performance testing/HPWH performance maps
- BEOpt 2 – fuel matching issue.

Acknowledgements

Thank you to the Department of Energy's Building America Program for providing the means to have a world class research program. Appreciation goes out to all the teams, labs, and DOE managers who continue to prepare for and actively participate in the Building America meeting series.