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

BUILDING TECHNOLOGIES PROGRAM

Summary of Needs and Opportunities from the 2011 Residential Energy Efficiency Stakeholders Meeting

Atlanta, Georgia — March 16-18, 2011

May 2011

Building AMERICA
U.S. Department of Energy

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Prepared for:

Building America

Building Technologies Program

Office of Energy Efficiency and Renewable Energy

U.S. Department of Energy

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Contents

ABOUT THIS REPORT

The needs and opportunities identified in this report do not represent the opinion or positions of the U.S. Department of Energy (DOE) or the National Renewable Energy Laboratory (NREL) and NREL and DOE do not necessarily agree with all of the points made by the meeting presenters. This report is not intended to be a complete summary of important needs and opportunities, but to address a small segment of key topics that were chosen for the meeting agenda.

PROGRAM BACKGROUND

Building America is part of the U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE), Building Technologies Program (BTP). Building America focuses on conducting the systems research required to improve the efficiency of the 500,000–2,000,000 new homes built each year, as well as the approximately 116 million existing homes.

Building America research accelerates the development of reliable and effective whole-house packages of measures for highly energy efficient new and existing homes that are tailored for each major U.S. climate region. This research can be implemented on a broad basis, while also reducing risks, increasing durability, and providing a reasonable return on investment. These improvements are accomplished through multiscale research, systems development, systems integration, large-scale field implementation and evaluation, and effective communication of key research results and system-based strategies. The near and long term performance targets for Building America have been updated to help guide the energy efficiency of homes past code requirements and current standard practices, as well as to provide technical support for new residential initiatives including DOE's BetterBuildings Program.

Since July 2010, the 15 research and deployment partnerships of the Building America program have begun projects that help dramatically improve the energy efficiency of American homes. These highly qualified, multidisciplinary teams work to deliver innovative energy efficiency strategies to the residential market and address barriers to bringing high-efficiency homes within reach for all Americans.
Visit the Building America website for more information about Building America teams, projects, partners and tools: www.buildingamerica.gov.

EXECUTIVE SUMMARY

The *Residential Energy Efficiency Stakeholders Meeting* was held in Atlanta, Georgia, on March 16-18, 2011. The meeting brought together more than 200 professionals representing organizations with vested interest in energy efficiency improvements in residential buildings. This team was assembled to help identify needs and opportunities for the U.S. Department of Energy's Residential Buildings Program. These stakeholders represent a variety of industries, including manufacturing, government, nonprofit, and private sector programs.

Source: Confluence Communications, reprinted with permission

The meeting identified or reinforced a wide variety of needs and issues associated with delivering high-performance homes in both new and existing home scenarios, including:

Needs:

- Create viable, accessible financing solutions.
- Simplify the process. Leverage existing transactions to educate homeowner and create opportunity for EE upgrades. Ensure follow-through after energy auditing.
- Develop and vet multiple business models to address the remodeling industry.
- Create and push consistent messaging. Show value and benefits clearly. Provide marketing support. Use simple, creative language.
- Leverage dollars from utility programs.
- Collaborate with trade alliances.

Issues:

- Difference between predicted and actual energy performance is significant.
- Behavioral impacts are significant.
- Appraised value hinges on proper data on EE upgrades, and data is lacking.
- Standardized methods for assessing long-term performance attributes for new building enclosure materials must be developed and implemented.
- Details for specific material applications/construction strategies must—and can be— developed and promoted collaboratively.

This meeting summary report captures stakeholder needs and opportunities as identified by presenters and attendees in 29 sessions. For presentation materials from this meeting, meeting archives, and future plans, visit the Building America website at www.buildingamerica.gov.

MEETING BACKGROUND

The U.S. Department of Energy's (DOE) Building America Program holds two public meetings per year:

- The spring ***Residential Energy Efficiency Stakeholders Meeting*** focuses on hearing from stakeholders on their perspective of key issues and needs related to advancing energy efficiency in housing to meet Building America goals and objectives.
- The summer ***Residential Energy Efficiency Technical Update Meeting*** focuses on hearing from Building America participants about their projects, results, and needs.

Participants in the Spring 2011 ***Residential Energy Efficiency Stakeholders Meeting*** included:

A.O. Smith Corporation	Greenbelt Homes
Abundant Power	GreenFiber
AEEREP	Habitat for Humanity International
Affiliated International Management	Hargrove Inspections
Affordable Comfort	HearthStone Homes
Allure Energy	The Home Depot
Appraisal Institute (Daniel Fries & Assoc.)	Honeywell
ARBI	IBACOS
Argonne National Laboratory	Ingersoll Rand Residential Solutions
ARIES Team - The Levy Partnership, Inc.	International Code Council
Asdal Builders	Johns Manville
Aspen Aerogels Inc.	K. Hovnanian
Baldwin Homes	Lawrence Berkeley National Laboratory
Building America Retrofit Alliance (BARA)	MASCO
Bartholomew Heating & Cooling	Michigan State University
BASF	Moore-Built Construction & Restoration Inc.
Bayer MaterialScience	NAHB Research Center
Best Buy Co., Inc.	National Association of Realtors
Blueseed Ventures	National Home Performance Council
Building Media	National Renewable Energy Laboratory (NREL)
Boise State University, CEERI	Navigant Consulting
Boston Redevelopment Authority	New Ecology
BOULD and Flatirons Habitat for Humanity	Newcomb and Boyd
Building Affordable	Newport Partners
Builder Partnerships	Next Phase Studios
Building Energy Diagnostics and Retrofits, Inc.	NJIT Center for Building Knowledge
Building Knowledge	NorthernSTAR Building America Partnership
Building Performance Institute	NREL
Building Science Corporation	NTA
CARB/ Steven Winter Associates	Oak Ridge National Laboratory
Cardinal Glass Industries	Owens Corning
Case Design/Remodeling, Inc.	Pacific Northwest National Laboratory
CLEAResult	Panasonic Home and Environment
CMC Energy Services	PFB Corporation
CNT Energy	Polaris

Community Preservation Corporation	R&D Services
Confluence Communications	RESNET
ConSol	RMI
Davis Energy Group	Sacramento Municipal Utility District (SMUD)
Dow	Seville Consulting
Dryvit	Southeast Energy Efficiency Alliance
DuPont Building Innovations	Southern Company
E3 Greentech Enterprises Inc	Southface Energy Institute
EchoFirst	St. Bernard Project
EEBA	Steven Winter Associates
EGIA	Structural Insulated Panel Association
U.S. Environmental Protection Agency	Sustainable Atlanta
Energy Vanguard	Sustainable Industries Incorporated
Energy Detectives	Tempo Mechanical Services
Ferris State University	The Pennsylvania State University
FirstService Residential	Tommy Williams Homes
Florida Solar Energy Center	Traveler Builders
Fraunhofer CSE	University of Florida
FSEC	U.S. Department of Energy
Georgia Department of Community Affairs	University of Florida
Gas Technology Institute	University of Minnesota
GE Global Research	University of Nebraska - Lincoln
Green Coast Enterprises	Urbane Environmentalist
Green Earth Equities	Vinyl Siding Institute
Green Homes America	Washington State University
	ZETA

The meeting focused on identifying research and implementation needs that could be addressed by the Building America program and other residential building initiatives. The meeting sessions were organized into three tracks of 60 minutes each, with two to four presenters per session and a question and answer period:

- Track A: Innovative Retrofit Programs and Strategies
- Track B: Perspectives on New Construction
- Track C: Technology and Implementation

Each session was facilitated by a member of a Building America research team, with the intent of focusing the outcome of the session on identifying needs and opportunities for collaboration with stakeholders.

Feedback from this meeting, documented in this report and in the presentation materials, will be used to help set future research areas, and to identify opportunities to partner with stakeholders in projects to improve the implementation of high-performance efficiency measures in both new and existing homes.

The next meeting in this series will be held on August 9-11, 2011, in Denver, Colorado.

MEETING SUMMARY: STAKEHOLDER NEEDS AND OPPORTUNITIES

Innovative Retrofit Programs and Strategies

Reaching and inspiring a broad audience in the residential retrofit industry requires unique approaches to research, development, partnership and deployment. This track focused on bringing together stakeholders who are currently involved in implementing large-scale community retrofit programs and partnerships, and whose work has the potential to help transform the residential market.

Scaling Residential Retrofits

Creating a significant energy savings impact for our nation means reaching a large number of homes. These sessions included representatives from: Sacramento Municipal Utility District, Electric and Gas Industries Association, FirstService Residential Management, GreenHomesAmerica, Green Earth Equities, and Next Step Living.

The following needs and opportunities were identified:

- A key problem is "lack of will," not lack of technical solutions or cost-effectiveness. People don't make logical choices (behavioral economics) and are more sensitive to losses than gains. Solutions need to address all income levels.
- Standards, financing, and wealth of bad information are key barriers.
- Need to leverage opportunities presented in existing transactions to talk homeowners into retrofitting and leveraging private sector investment. A valuable time to educate homeowner is during the audit. Several presenters stressed the need to create a "one-stop shop" where consumers see complete packages delivered by one team of people, vs. ala carte options.
- Need to create consistent messaging, standards, and requirements.
- Increasing budgets for EE programs in utility environment creates a leverage opportunity.

Changing the Market through Innovative Partnerships and Initiatives

Strategic partnerships between organizations take full advantage of crosscutting resources and opportunities to improve energy performance. This session included representatives from National Home Performance Council and Affordable Comfort, Inc. (ACI).
The following needs and opportunities were identified:

- Durability and indoor air quality are non-negotiable parts of deep energy retrofits.
- When the homeowner recognizes the need and opportunity for a major energy retrofit, they will lead the project and become highly motivated to go beyond the original scope of the project.
- A key challenge is finding professionals and subcontractors who share the project's frame of reference.
- Previous suboptimal improvements can limit future improvements. The value proposition needs to be presented and must go beyond purely financial.
- The process of energy retrofits must be simplified.
- We don't have enough data to know how systems perform at partial loads.

- Getting homeowners to understand that there is quality in energy efficiency is critical.
- Energy programs for contractors and others need marketing support.
- Building trust between the contractor and the homeowner is critical, especially in energy retrofits.
- Financing tools with low interest rates are a key incentive to get more people involved in the energy retrofit process.

Marketing and Occupant Behavior in Retrofits

Renovating and building energy-efficient homes is only part of the challenge—convincing homeowners and investors to pay for energy improvements, and operate their homes efficiently, presents an additional challenge. This session included representatives from Seville Consulting and Polaris, Inc.
The following needs and opportunities were identified:

- We are so close to real high-performance houses but there aren't enough people buying them.
- Demand is low, the sales process of selling high-performance homes is difficult, and the paradox is that even if we deliver a high-performance home, people will just buy more stuff and use more energy.
- The biggest challenge to this industry right now is that we don't know how to sell to our customers.
- When looking for ways to market to potential customers, viral social media marketing can make high-performance homes "sexy" and also, or more importantly, make the alternative look unacceptable.
- Marketing efficiency requires political will, public awareness, and provider awareness, but we need the government to lead this effort with strong political will and a national effort.
- In the work of home performance we are now at the point of incremental leaps of improvement. However in the business of selling home energy performance we need help to make quantum leaps to get the market demanding higher performing homes.
- Changing our (the current industry's) behavior about selling high-performance homes is our greatest opportunity, and our greatest barrier to success today.
- Workshops and local community events are one of the best opportunities we have to introduce home energy retrofits to homeowners.
- When trying to market and sell to homeowners about home energy improvements, the environmental issue is challenging because of the highly politicized debate over global warming. We can talk about cheaper utility bills, comfort, better IAQ and energy independence, in general.

Standardization, Operational Challenges, and Verification

Well-designed systems don't always result in high-performance homes. Installation, maintenance and occupant behavior can radically impact end performance. This session included representatives from Affordable Comfort, Inc. (ACI) and the Office of Housing and Community Development, Sarasota.
The following needs and opportunities were identified:

- Motivation for behavioral change is varied and unclear. There is a need to determine what motivates and supports behavioral change—dollars and savings or value and marketing—or both? Need to recognize that accepting something new isn't easy.
- Choices should be made simpler, more obvious, and more "one-stop shop" for customers who don't want to think, and create better roadmaps for those who do.

- We need to understand the differences between modeled and actual energy performance and address the gap, and understand interactions that might not lead to expected energy savings.
- Shift focus to satisfying occupants/customers from "not wanting a callback."
- Cookie-cutter solutions are not always appropriate. Automatic replacement of ducts, for example, was a waste of money in one presenter's projects, and EE equipment is not always available.
- The older the home, the more cost effective the energy improvements were.
- Projected and actual savings sometimes have large discrepancies for envelope upgrades. Actual performance is an issue and systems integration, controls, etc., need to be analyzed.
- Under-performing high-performance systems can perform worse than their "low-performance" counterparts.

Transforming Residential Retrofit Strategies to Fit the Market

Creating and verifying viable retrofit programs to meet market demand is a unique challenge. This session included representatives from: CMC Energy Services, the Boston Redevelopment Authority, and the National Home Performance Council.

The following needs and opportunities were identified:

- Home performance data collection needs to be standardized, automated and integrated between programs, but we could be asking for too much data.
- Historic preservation needs to be considered in retrofit, and windows are a particular challenge.
- Need to consider home energy management systems.
- Software overpredicts savings, can't properly quantify take-back effects or differences in occupant behavior.
- Significant numbers of people are disappointed because energy savings were less than promised.
- People want payback of less than 5 years.

Financial Incentive Programs for Clean Energy/Retrofit

Lack of access to funds is often a key barrier to the success of otherwise healthy high-performance building programs and initiatives. This session included representatives from: Abundant Power, Community Preservation Corporation, and Next Step Living.

The following needs and opportunities were identified:

- To get unsecured rates lower, loans will need to be bundled, have government mandates, corporate sponsors or have vendors incorporate the rate "buy down" in costs, which then get passed to consumers or something else to reduce investor risk. Also need local precedent.
- Need low default loan rates and Wall Street will pay attention.
- Lenders don't buy if no data about energy efficiency measures.
- There is an opportunity to underwrite the energy portion of the mortgage and lenders will buy into it.
- Financing is about people's discount.
- Give people things (like energy upgrades) up front and make money back on interest. People will do this because they have a discount rate that is much higher than the interest rate.

- To do this:
  - Work with cities (water utility) to collect money
  - Loan money to the city to "give" to residents, enough to do an upgrade, ~$4K.
- This will create a track record so that these loans will eventually become securitizable.
- Loan loss reserve funds: financing industry doesn't believe this will work, they don't believe in green mortgages

Challenges in Whole-house Retrofits

Whole-house retrofits present an incredible potential to reduce our nation's energy use, while creating a significant challenge because of variability. This session included representatives from: CASE Design/Remodeling, Greenbelt Homes, and CNT Energy in Chicago.

The following needs and opportunities were identified:

- The home remodeling industry is about a $250 billion a year market but it is really segmented as far as the type of work that is done. One of the biggest challenges we have is being able to turn the conversation about simple home improvement toward a conversation about home energy improvements.
- The remodeling industry is so easy to enter that when the economy slows it becomes increasingly competitive as new companies enter the market. Most of these newer businesses go out of business within 5 years but it puts intense pressure on existing remodeling companies.
- There are operational challenges when working with building superintendents.

Perspectives on New Construction

Strategies to significantly improve the performance of new homes vary based on region, housing type (i.e., affordable, production) and market. This track focused on bringing together stakeholders who are currently involved in a range of new construction strategies to give perspective on key opportunities and challenges.

New Construction Strategies

Business strategies to deliver high efficiency, high-performance new homes are rapidly evolving to meet market needs. These sessions focused on:

- The delivery of high-performance energy housing by ZETA Communities
- How-to market energy savings features and options by Baldwin Homes
- A production builder's perspective on energy efficiency in housing by K. Hovnanian and HearthStone Homes
- A whole-house energy guarantee program to be delivered by Bayer Material Sciences through spray foam contractors
- An overview of the market based on results from a national survey of homebuilders by Builder Partnerships
- An update on the ENERGY STAR for New Homes Program.

The following needs and opportunities were identified:

- There's clearly a linkage between time, economics, and energy efficiency—do things faster and save energy and money.
- Marketing net zero energy and energy efficiency is difficult, people don't understand. They think they won't be able to use as many things in the house.
- There is no single source of information for incentives.
- Not everyone has an energy modeling budget.
- Marketing of very high-performance homes is tough—appraisal, finance and education challenges.
- Codes are driving, but some builders want to figure out how to do it before we are required to do it.
- Concerns with high efficiency: risk management and unintended consequences; don't want problems in the name of improvement; necessity to train all those that touch it.
- The challenge is going forward because the low hanging fruit is gone.
- How do we get customer and management attention going forward?
- Concern about Builders Challenge/ENERGY STAR/HERS rating—DOE and industry need to be on a single page with one mileage sticker.
- Need to allow renewable energy in the Building America platform.
- Production builders need standardized installation times, understanding of costs, education on building science fundamentals, and availability of skilled labor.
- Builders are investing in the thermal envelope, but not seeing the lowered cost effect of smaller HVAC. They are making the envelope tighter, but not ventilating. Process is as important as technology.
- How do we educate? Occupant behavior has a big effect. What if occupant pre-paid utilities for energy (like filling up gas tank before driving)? Would that make occupants pay more attention?
- Design with end in mind; be committed to scopes of work; understand impact of individual parts.

- HVAC industry is a big challenge.
- Challenge early was the lack of energy raters. Focus is now on performance—performance is often missed in rating software.
- Poor installation practices across the United States.
- Items like pressure balance, comfort, ventilation, combustion safety not captured adequately in modeling.
- ENERGY STAR can/wants to use Building America research to show how to reach V4 goals.
- Building America could work with ENERGY STAR on Field Guides, making these the core documents, constant works in progress.
- In Builder Partnership survey, energy efficiency was #3 in importance after consumer demand and financing; moisture issues was #7.
- Cost is important to builders because it's important to consumers.
- Builders want leadership and a clear message to the consumer.
- Sources of information on energy efficiency—need improvement from Building America (most had never heard of it). Most common source of information was suppliers.
- Barriers: appraised value, lack of willingness to pay, lack of energy-efficient mortgages.
- Want a feedback loop— energy monitoring.
- Need to show profit in energy efficiency and other real benefits.

Affordable Housing Strategies

Achieving energy efficiency on a minimal budget with unskilled, volunteer labor is not for the faint of heart. This session included representatives from Habitat for Humanity.

The following needs and opportunities were identified:

- Need to focus on basic principles: simple, decent, affordable.
- Start with small footprint.
- Keep volunteer labor in mind.
- Focus on more than the house—neighborhood revitalization.

Rebuilding Communities

Truly affordable, energy-efficient building and rebuilding strategies are a particular challenge, especially in areas devastated by disaster. This session included a representative from Green Coast Enterprises and the Saint Bernard Project.

The following needs and opportunities were identified:

- New Orleans is still in a housing crisis.
- There is a large gap between affordable housing stock and need.
- There are a large number of blighted properties.
- Data needs to drive decisions.
- Emphasis has to be toward long-term success.

- There are opportunities for housing programs—many families living doubled and tripled-up. There are opportunities to rebuild blighted housing.
- Program works well for rentals as well.
- Need to create housing that people can stay in.

Driving Consumer Awareness

Compelling consumers to care about energy efficiency is a key concern in driving energy performance. If they won't buy it, it won't fly. This session included representatives from: Tommy Williams Homes, Energy Detectives, and the Boston Redevelopment Authority.

The following needs and opportunities were identified:

- Consumer willingness to buy is necessary.
- Winning a sales battle moves the energy-efficient product faster than science can.
- Instead of focusing on features, focus on benefits.
- Use creative names.
- Show the benefit and tie it to the consumer.
- Opportunity to evaluate performance and drive consumer awareness with aerial and street level infrared analysis.
- There is a lot of misconception of the smart grid.
- Electricity usage is increasing and consumers are willing to pay to get information.
- The majority of consumers would buy an energy monitor if it would help them lower their energy costs by half the cost of the monitor.
- The public, once educated, is willing to pay and can make good decisions with information.

Water and Energy

Water heating and delivery systems have significant impact on energy consumption, but are often overlooked by building energy professionals. This session included representatives from: the International Code Council (ICC), Affiliated International Management, and A.O. Smith.

The following needs and opportunities were identified:

- Building America needs to move beyond energy consumption to also include embedded energy use; decouple humidity and temperature control; and establish appropriate water quality for non-potable water.
- Could use Building America expertise on energy and water monitoring.
- Builders don't know who Building America is—be part of the code process.
- Behavior has a big impact on hot water use.
- Plumbing systems makes a big difference.
- People want instantaneous and continuous hot water.
- Code solutions needed to create enough space to implement.
- How to get code compliance—table precision is useless. Calculations before construction don't work, need verification day before Certificate of Occupancy.

- Need to take envelope into account when using electric heat pump.
- Solar water systems getting into the market again. Backup tank does not have to be electric, but water heater has to be able to provide 100% of hot water needs.
- Regulatory issues have an impact.
- Covered under National Appliance Energy Conservation Act and Energy Policy Act of 2005—size determines division between residential or commercial.
- Most efficient condensing gas tank water heaters are not eligible for ENERGY STAR because of the line between NAECA and EPACT.
- Recirculation loops can turn 96% water heater into an 80% efficient water heater. Have to think about recirculation loop and the interaction with the water heater system.
- Well set up demand system can minimize the impact of a recirculation loop.
- Condensate is acidic, however, activity level is important. Soap neutralizes condensate, however codes still require neutralizers.
- Heat pump water heaters are starting to use the term "Aerothermal." They need 1000 cubic feet of air. Venting location is important.
- Heat pump blows cold air into the house and dehumidifies, but cooling can be a problem in the winter.
- Combination systems are a good thing.
- Tankless water heaters: application has to be right (initiation cycle each time started) can waste water.

State of Green Real Estate – Valuing Energy Efficiency

Valuing energy efficiency is a consistent challenge, particularly in its inconsistencies. This session included representatives from the EcoBroker/Association of Energy and Environmental Real Estate Professionals (AEEREP) and Newport Partners.

The following needs and opportunities were identified:

- Data challenges caused initial results to evaluate the repeat sale index model to measure the difference in appreciation rates between energy-efficient homes and homes built with standard construction practices to be not statistically significant.
- The repeat sale index model poses the following data *gaps and barriers*:
    - No central collection of ENERGY STAR addresses
    - No standardization of ENERGY STAR records from HERS provider to HERS provider
    - Home sales databases often don't include first sale of home (MLS-based)
    - Limited history of green or energy-efficient programs
    - Limited sample size of both ENERGY STAR and control group homes across only two MSAs
    - Limited sample size due to inaccurate or incomplete data.
- Standard appraisal forms don't allow enough space for comprehensive description of energy efficiency upgrades.
- Green building features in most cases will increase the energy efficiency of a home, but will add to its cost. The savings in energy costs may or may not offset the additional cost to construct or install.
- Appraisal Institute is resource for finding "green" appraisers and for educational resources.
- There are many different types of customers with as many different financial situations.
- Some have money and credit and can easily find financing; others do not.

- Customers are not aware of the different types of financing available to them.
- Be a good and trusted resource on financing. People don't have money or credit, need financing. Contractor has to bring financing: utility, federal, state, Energy Saving Performance contracting, other.
- There are great programs available for homeowners:
    - FHA's Streamline 203(k) Mortgage
    - HUD PowerSaver program
    - VA Interest Rate Reduction Refinancing Loan (IRRRL).

Technology and Implementation

Strategies to significantly improve the performance of new homes vary based on region, housing type (i.e., affordable, production) and market. This track focused on bringing together stakeholders who are currently involved in a range of new construction strategies to give perspective on key opportunities and challenges.

New Standards and Certifications

Education and certification strategies to ensure properly trained professionals are a key issue in high-performance housing. This session included representatives from: Residential Energy Services Network (RESNET), the Building Performance Institute (BPI), the NAHB Remodelers, and the National Green Building Standards.

The following needs and opportunities were identified:

- With 107 million homes needing energy retrofits, we need multiple business models that approach auditing and contracting home energy retrofits.
- Too often in the past we talk about process and products in the energy retrofit agenda, but we have to move from that and start looking at total solutions for homeowners.
- Whole-house energy audits waste energy and money if they are not converted into actual energy retrofit projects.
- Building America needs to participate at a working group level to help keep building relevant and timely standards.

High-Performance Enclosures

Innovative wall systems and insulation materials present unique opportunities and challenges in both new and existing construction scenarios. There were two sessions covering high-performance enclosures. Session 1 included representatives from: the Structural Insulated Panel Association (SIPA), and NTA, Inc.

The following needs and opportunities were identified:

- The stakeholders, with input from industry, should establish standardized methods for assessing long-term durability, strength, and other key aspects of performance for new/innovative materials—especially non-cladding materials that resist structural loads. This would require establishment of simple and consistent performance criteria and methods for assessing those criteria. The key difference from existing standards/approaches would be to establish such criteria in a manner that is not material-specific so that any new product may be evaluated in an unbiased and transparent manner.
- Currently, for new/innovative materials each industry (e.g., foam sheathing, wood-plastic composites, cement boards, etc.) addresses key material aspects, such as strength and durability, in inconsistent ways and often to maximize the marketing potential of the product. This creates confusion and distrust in the marketplace and hampers introduction and acceptance of new materials into the marketplace.
- Use of SIPs in retrofit demands an additional cladding installation over the SIPs.
- Data on cost-effectiveness of retrofit insulated panels is not available.
- Seismic consideration to use of SIPs in retrofit and new construction.

- Lack of software to analyze structures.
- Potential drying issues in insulated vinyl siding.
- Misperception/skepticism of insulated siding R-value claims, when claims backed by legitimate testing done by Building America member laboratory, ORNL.
- Obtaining broader recognition of insulated siding in the context of WAP. Exposing raters to product as viable insulation alternative.
- Determine optimum thickness of SIP Nailbase for typical existing wall and ceiling/roof configurations for the least cost in each climate zone to achieve specific energy performance benchmarks in existing and future energy codes and goals.
- Create standardized connection details for wall and roof applications based on engineering wind loads, dead loads, snow loads and seismic.
- Address seismic and high wind considerations for use of SIPs in retrofit and new construction. Develop design parameters to determine the contribution of retrofit panels to the structural integrity of the building.
- Develop educational outreach to retrofit contractors to teach them air tightness principles, HVAC design impact and proper application techniques. This can be incorporated in a new chapter in the Builder's Guide to Structural Insulated Panels (SIPs).
- Develop guidelines for HVAC replacement and design in a SIP Nailbase energy retrofit. Since a SIP Nailbase retrofit will produce air leakage rates and insulation levels nearly as good as a SIP structure, HVAC systems will be grossly oversized for the new configuration. Adding a finish to the retrofit panel, the benefit is huge.
- Performance criteria and standard methods, once established, should be vetted by applying the concepts in case studies that evaluate new materials, such as MgO panels, wood-plastic composites and/or structural foam sheathing. Innovative materials used by various stakeholders could be assessed in a consistent manner and the results compared and contrasted to further refine the performance criteria.
- Develop software that can rapidly analyze structures.
- Ability to qualify the assemblies in high seismicity regions.

Session 2 included representatives from Greenfiber and Aspen Aerogels.

The following needs and opportunities were identified at this session:

- Different manufacturers can collaborate to deliver high quality information on insulation benefits to the market.
- New insulation systems (Aerogel) create opportunity areas for Building America teams to solve envelope issues.
- Collaborations can take place amongst competitors when inspired by a recognized market need. It is possible to get coalitions of competitors working together to deliver collaborative research.
- In difficult economic climate, companies have expended the private funding available and need public funding to wrap up the work already completed.
- Ineffective dissemination of information concerning new solutions and/or materials is a barrier to accelerating market penetration and acceptance.

Education and Outreach Tools

Technical training is a critical need among raters, trades and builders. In addition, contractors must be educated to properly "sell" energy efficiency solutions. This session included representatives from the Electric and Gas Industries Association (EGIA), and the Energy and Environmental Building Association (EEBA).

The following needs and opportunities were identified:

- The terminology, metrics and visuals used by the heat pump industry do not always resonate with homeowners.
- Identify key disconnects between heat pump industry and homeowner perceptions of key issues, terminology and metrics.
- Disconnect in communication can hamper customer uptake, thus slow speed/scale.
- Ensure communication disconnects are addressed within, or in parallel with, Building America research.

Renewable Energy Technologies

Installation and cost are two key components of successful renewable energy systems for new and existing homes. This session included representatives from GE Global Research, and EchoFirst. Highlights included:

- The three market channel opportunities for solar installation are: new construction, direct sales to (and through) local utilities, and working with roofing contractors (7 million asphalt rooftops are replaced a year in the United States and two-thirds of those are solar ready).
- Whole home energy management software and awareness is the key to increased energy efficiency nationally.

Air and Moisture Management in Enclosures

Highly insulated, high-performance wall systems have had significant technical advancements in recent years, including both system design and component parts. This session included representatives from DuPont Building Innovations, and Cardinal Glass.

The following needs and opportunities were identified:

- Need to develop details for water and air barrier continuity especially in newer, more energy-efficient wall systems.
- Energy-efficient construction introduces challenges for durable construction.
- Industry needs to learn how to overcome these challenges.
- Installation details need to be worked on as an industry.
- Details should be tested as systems; protocol should challenge installation with structural and thermal cycling.
- Regarding ENERGY STAR internal shading:
    - Scalar use causes overprediction of shade effect on low-e glass
    - Model assumes windows open two-thirds of time in winter and closed two-thirds of time in summer. We need more human interaction data to verify these assumptions (e.g., do homeowners use shades for privacy or solar control?)

- Data from LBNL about comfort indicates overheat is a concern that has to be addressed. Building America research confirms solar discomfort.
- Key question: "Should window energy savings be based on thermostat offsets for 'equal' comfort?"
- Industry and Building America can work together to test mockups of wall/window/door systems and make test results available to everyone.
- Building America can work with window manufacturers to optimize the benefits (energy savings, cost savings, comfort, durability, etc.) of window upgrades.

Challenges/Barriers Identified

- There is a need to develop details for water and air barrier continuity.
- One entity cannot test all variations of wall/window/door systems.
- As we move to more efficient buildings, the ability of assemblies to dry out diminishes.
- Manufacturers are specifying to install products according to other manufacturers' instructions, which can lead to circular referencing.
- ASTME E2112 and *EEBA Water Management Guide* cover a few flashing situations in detail and are primarily concerned with traditional wall designs; details are needed for more products going into high-efficiency wall systems.
- The market is slow to change. Key example: adoption/enforcement versus one-third of market still buying (clear glass) product that is not code compliant.
- Complex performance path codes are not as effective at transforming the market.
- Savings predictions are not typically based on thermostat offsets that provide "equal" comfort.
- Window manufacturers must be able to supply new window technology across entire market line.

Key Issues to be Addressed in Collaborative Research

- Developing laboratory test procedures for mockups of wall/window/door systems.
- Field testing of wall/window/door systems.
- Developing list of basic philosophies for detailing window retrofits (Do's and Don'ts).
- Developing orientation-specific window performance recommendations.
- Economics of replacing single-pane, clear glass.
- Overprediction of shade effect on low-e glass for ENERGY STAR Internal Shading.
- Validating shading assumptions using human interaction data.

Innovations and Challenges in HVAC – Addressing Whole-House Performance and Comfort

This session discussed interactive controls and system interaction for both utilities and homeowners by Trane, and strategies to educate consumers and HVAC contractors by Bartholemew Heating & Cooling.

The following needs and opportunities were identified:

- As houses get very efficient, HVAC has to be fully integrated with the other systems. With smaller loads, ventilation and humidity need to be addressed.
- Biggest challenge is educating the homeowner. Educate consumers on the comfort and efficiency benefits of home performance.
- Comfort is more important than energy efficiency.

- There is a synergy between HVAC and home performance contractors. The key factor is to educate their work force, particularly technicians that visit the house.
- Trade alliances: the biggest opportunity to promote home performance. Different trades get access to each other's customer base and each contractor can offer complete solutions.

Opportunities for collaboration amongst organizations:

- Collaborate with national labs to assess and optimize U.S. HVAC retrofit opportunities.
- Home performance and auditing organizations would benefit from alliances with HVAC trade organizations for access to the larger (consumer comfort and problem solving) market. HVAC industry would do well to partner with the home performance industry for the ability and knowledge to solve problems and offer complete comfort solutions.

Challenges or barriers identified:

- Homeowner knowledge on comfort and energy efficiency.
- Alignment of policy issues and regulation to incentivize how the adoption of new beneficial HVAC technologies for the home performance industry is best suited to offer complete solutions**.**

Key issues that should be addressed in collaborative research:

- In very energy-efficient houses, integration of the cooling equipment with the other energy efficiency measures.
- How to educate homeowners in large scale.
- Lack of current or recent residential HVAC research work focused on advanced ducted variable speed systems as an alternative to Asian ductless systems.
- Inclusion of current U.S. HVAC OEMs in national lab research projects.

Other key points:

- Variable speed can deliver energy savings without compromising the comfort as much as thermostat setbacks and cooling equipment shutoffs.
- Trade alliances present a very promising opportunity for delivering home performance to large number of houses.

Home Energy Management Systems

Home energy management systems provide a valuable opportunity to eliminate residential energy waste. This session included representatives from: E3, Energy Detectives, and Best Buy.
The following needs and opportunities were identified:

- Study by Verizon found the largest hurdle is consumer awareness. Homeowners would purchase a device if they can save 50% of what they paid for the device.
- Need to find out what characteristics are important to your customer.
- Making technology simple and fit for lifestyles is most important.
- Wide gap between consumer interest in doing it the right way and knowing how to do the right thing.
- Energy management must integrate itself into everyday lives. Apps need to meet consumer demand.

- No one-size-fits-all.
- Technologies and trends: more devices have ability to connect, yet, few are connected.
- In homes there can be six networks: HVAC, irrigation, security, audio, lighting controls, home theatre. They all come in different protocols. Homeowners are dealing with complex situations. The need is to help clean it up, so consumers can make choices based on data they have. And they can make their systems into the desired and simple.

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