

# Expert Meeting Report: Key Innovations for Adding Energy Efficiency to Maintenance Projects

A. Wood and J. Wiehagen  
*NAHB Research Center*

September 2012

## NOTICE

This report was prepared as an account of work sponsored by an agency of the United States government. Neither the United States government nor any agency thereof, nor any of their employees, subcontractors, or affiliated partners makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States government or any agency thereof.

Available electronically at <http://www.osti.gov/bridge>

Available for a processing fee to U.S. Department of Energy  
and its contractors, in paper, from:

U.S. Department of Energy  
Office of Scientific and Technical Information  
P.O. Box 62  
Oak Ridge, TN 37831-0062  
phone: 865.576.8401  
fax: 865.576.5728  
email: <mailto:reports@adonis.osti.gov>

Available for sale to the public, in paper, from:

U.S. Department of Commerce  
National Technical Information Service  
5285 Port Royal Road  
Springfield, VA 22161  
phone: 800.553.6847  
fax: 703.605.6900  
email: [orders@ntis.fedworld.gov](mailto:orders@ntis.fedworld.gov)  
online ordering: <http://www.ntis.gov/ordering.htm>



Printed on paper containing at least 50% wastepaper, including 20% postconsumer waste

## **Expert Meeting Report: Key Innovations for Adding Energy Efficiency to Maintenance Projects**

Prepared for:

The National Renewable Energy Laboratory

On behalf of the U.S. Department of Energy's Building America Program

Office of Energy Efficiency and Renewable Energy

15013 Denver West Parkway

Golden, CO 80401

NREL Contract No. DE-AC36-08GO28308

Prepared by:

A. Wood and J. Wiehagen

NAHB Research Center

400 Prince George's Blvd

Upper Marlboro, MD 20774

NREL Technical Monitor: Stacey Rothgeb

Prepared under Subcontract No. KNDJ-0-40335-00

September 2012

**[This page left blank]**

## Contents

List of Figures .....	vi
List of Tables .....	vi
Definitions.....	vii
Executive Summary .....	viii
<b>1 Background.....</b>	<b>1</b>
<b>2 Introduction.....</b>	<b>1</b>
<b>3 Expert Meeting Plan: Key Innovations for Adding Energy Efficiency to Home Maintenance Projects.....</b>	<b>3</b>
3.1 Motivation for the Meeting.....	3
3.2 Meeting Topic.....	3
3.3 Purpose and Objectives.....	4
<b>4 Expert Meeting Summary .....</b>	<b>5</b>
4.1 Meeting Introduction .....	5
4.2 Adding Energy Efficiency Upgrades to Attic from Exterior.....	5
4.2.1 Roof Replacement: Adding Energy efficiency Upgrades at Attic from Exterior.....	5
4.2.2 Gaps and Barriers: Technical Issues.....	8
4.3 Key Innovations – New Insulated Roof System.....	8
4.3.1 Roof Replacement: Key Innovations – New Insulated Roof System.....	9
4.3.2 Gaps and Barriers.....	10
4.4 Attendees.....	11
4.5 Next Steps.....	11
<b>References.....</b>	<b>13</b>
<b>Appendix A: Expert Meeting Agenda.....</b>	<b>14</b>
<b>Appendix B: Introduction Presentation – NAHB Research Center.....</b>	<b>15</b>
<b>Appendix C: Adding Energy Efficiency to Roof Replacement – Energy Services Group.....</b>	<b>19</b>
<b>Appendix D: Expert Meeting Discussion Points – Adding Energy Efficiency to Roof Replacement .....</b>	<b>23</b>
<b>Appendix E: Roof Deck Energy Upgrade – Zero-Energy Plans .....</b>	<b>24</b>
<b>Appendix F: Expert Meeting Discussion Points – Insulated Roof Deck .....</b>	<b>33</b>
<b>Appendix G: Expert Meeting Attendees .....</b>	<b>34</b>

## List of Figures

**Figure 1. 2009 remodeling spending by homeowners ..... 2**

*Unless otherwise noted, all figures were created by the NAHB RC team.*

## List of Tables

**Table 1. Expert Meeting Attendees ..... 34**

*Unless otherwise noted, all tables were created by the NAHB RC team.*

## Definitions

BA	Building America
DOE	U.S. Department of Energy
HVAC	Heating, ventilation, and air conditioning
IBS	International Builders' Show
NAHBRC-IP	NAHB Research Center Industry Partnership
ROI	Return On Investment
STC	Standing Technical Committee

## Executive Summary

Energy efficiency upgrades to existing homes are often thought of in a whole-house setting where energy improvements have been identified through an audit process, which provides the homeowner an extensive list of recommendations. This approach often results in only a subset of the recommendations being completed either as part of an energy upgrade or as part of another remodeling effort due to financing and other impediments. Similarly, many homes have major repair work performed due to needed maintenance or as a result of some damage, but rarely do these maintenance projects incorporate complimentary energy upgrades. As a consequence of these often lost opportunities, the NAHB Research Center Industry Partnership proposes to explore ways to enhance energy efficiency in existing homes that would complement typical larger maintenance/ remodeling projects.

To help the Research Center explore the topic of addressing energy efficiency in maintenance projects, an expert meeting was planned in conjunction with the 2012 International Builders' Show (IBS) on February 8, 2012, in Orlando, Florida. The topic, *Key Innovations for Adding Energy Efficiency to Maintenance Projects*, was intended to provide direction to more focused efforts to increase the efficiency of existing homes; in this meeting, the focus was specifically for re-roofing and the opportunities for adding energy efficiency upgrades during this major home repair activity. The two-fold purpose for the expert meeting was to expand the Building America (BA) program knowledge base and to focus the future research goals to address energy upgrades in existing homes.

Key outcomes from the expert meeting included:

- General agreement that adding energy efficiency to maintenance projects, specifically roof replacement, is a real and timely opportunity for roofing companies. This is achievable and can result not only in additional profit centers for the companies, but cost savings and better long-term performance for the homeowner. These additional homeowner benefits are often overlooked in many re-roofing projects.
- A clear acknowledgement that this approach can easily be extended to other major maintenance/remodeling projects to address the needs within the energy retrofit industry.

The lessons learned from this meeting will be used by the NAHB Research Center Industry Partnership, as well as the BA Standing Technical Committee (STC) for Implementation Tools, to refine its retrofit research agenda and objectives as they relate to energy retrofits. In addition, the results will support the BA teams' work in implementing energy efficiency into remodeling projects.



## 1 Background

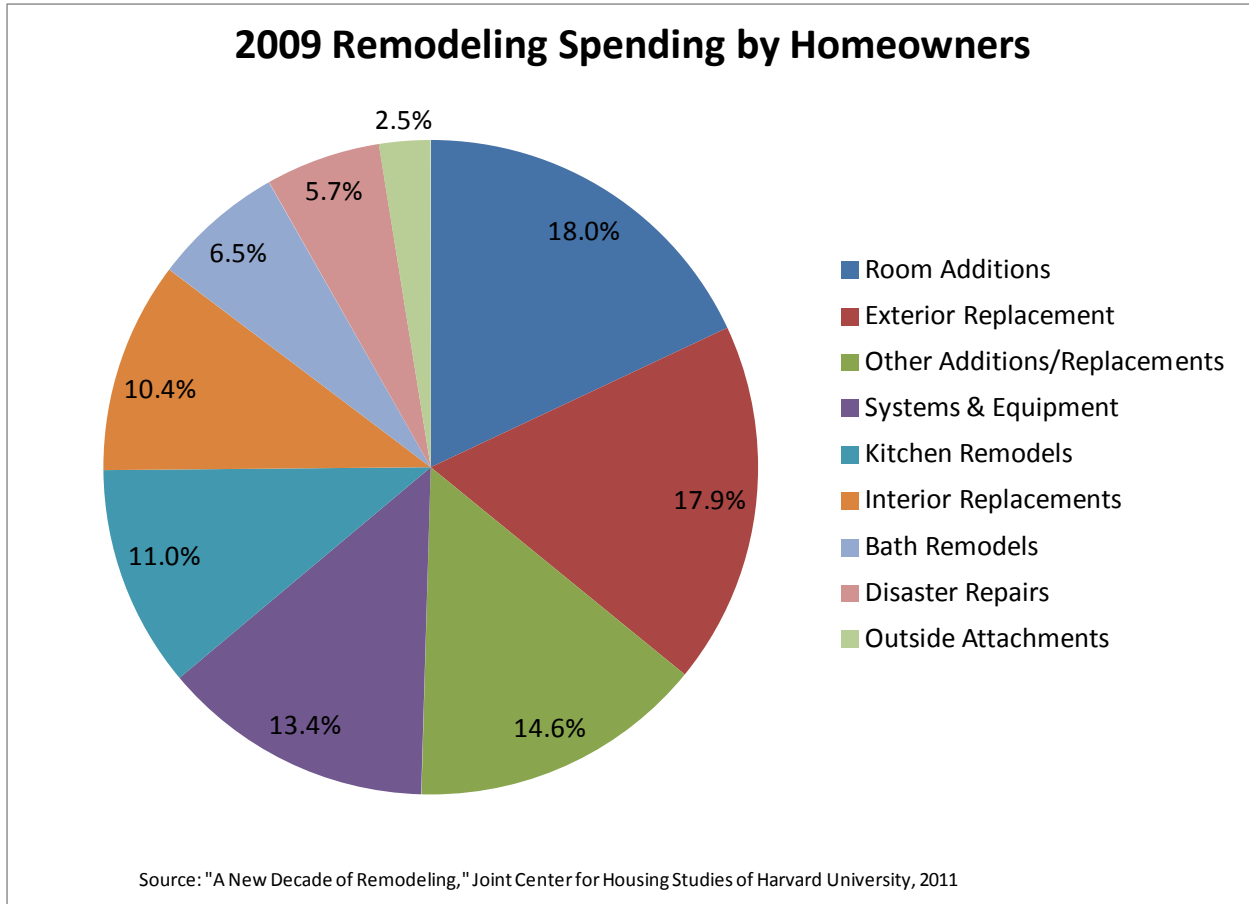
The U.S. Department of Energy’s Building America (BA) program is a research program that aims to develop cost-effective, energy efficient solutions for new and existing homes within all U.S. climate zones. This goal will be met using a whole-house system engineering approach and by uniting segments of the industry that traditionally work independently of one another, including architects, engineers, builders, remodelers, trade contractors, utilities, manufacturers, material suppliers, community planners, and mortgage lenders.

Historically, the focus of the BA program has been to accelerate the development of energy innovations that reduce operating costs, increase durability, increase health and safety, increase comfort, and reduce energy use by validating benefits and costs via whole building research studies. Traditional BA research activities focus on advancing successful system innovations that are “deployment-ready.” This includes developing a clear understanding of why specific approaches work better than others and key building science specifications that are required for use in voluntary deployment programs like ENERGY STAR<sup>®</sup> and utility demand side management (DSM) programs.

## 2 Introduction

Improving the energy efficiency of existing homes is of increasing importance in the BA program and crucial to achieving sustained energy savings in U.S. housing. While the number of residential energy efficiency programs has grown significantly over the past 10 years, their primary success has been in the realm of weatherization that focuses on techniques designed to easily locate, seal, and/or insulate the major areas of an older building where energy losses are evident and the costs of the improvements are minimal. Major efficiency upgrades such as substantial wall and ceiling insulation and air sealing; duct, and HVAC system improvements; and foundation insulation enhancements are often much more costly and less likely to be implemented, even when an energy audit might have recommended the improvement.

While energy efficiency upgrades are often considered in a whole-house setting, this approach is often limited in remodeling projects due to funding and other impediments. As shown in Figure 1, much of the money spent by homeowners in remodeling is for an individual project. Because of this, there is an opportunity to discuss energy efficiency upgrades during these individual projects. However, in discussions with market remodelers, this approach takes careful planning to ensure that the energy upgrades are within the scope of the project requested by the homeowner. For example, if a homeowner is remodeling the kitchen, it is challenging to discuss attic insulation. However, energy efficient lighting and appliances as well as upgrading exterior wall insulation in the kitchen are within the scope of the project and offer the potential to enhance the project.



**Figure 1. 2009 remodeling spending by homeowners**

As a result, the NAHB Research Center Industry Partnership proposed that there could be an opportunity to explore ways to enhance energy efficiency in existing homes through typical maintenance or remodeling projects. Addressing energy efficiency in typical maintenance/remodeling projects is advantageous because some projects allow opportunities that provide access to otherwise inaccessible areas. For example, during a roof replacement, there is the opportunity to remove the roof deck to air seal around the top plates of the house. In many homes, this would be the only time that this area is accessible and visible.

To explore the topic of addressing energy efficiency in typical maintenance/remodeling projects, the NAHB Research Center hosted an expert meeting in conjunction with the 2012 International Builders’ Show (IBS) on February 8, 2012, in Orlando, Florida, titled *Key Innovations for Adding Energy Efficiency to Maintenance Projects*. Building America expert meetings are a strategic planning tool focused on key system areas that help to advance the knowledge of the BA program. These meetings assist in building partnerships with groups and experts outside of BA as well as gather feedback on current research, and identify next steps, gaps, priorities, and opportunities with maximum impact for BA systems research. The results of an expert meeting include specific conclusions about the research topic, action items, and next steps.

### **3 Expert Meeting Plan: Key Innovations for Adding Energy Efficiency to Home Maintenance Projects**

The expert meeting is one of several efforts by the NAHB Research Center to meet with leaders and experienced professionals within the existing homes sector who have expertise in energy retrofits to identify the gaps and barriers of implementation. In addition, the meeting reviewed innovative systems and system performance specifications that provide substantial benefits to stakeholders and homeowners that can ultimately be implemented on a broad basis. This is of particular importance in remodeling due to the high degree of industry fragmentation and consumer involvement in every aspect of the remodeling process.

#### **3.1 Motivation for the Meeting**

There are several reasons to consider adding energy efficiency to home maintenance/remodeling projects. Some of these include:

- Larger maintenance/remodeling projects are opportunities where a contractor is already performing significant work on the house and can offer energy efficiency upgrades, often at a lower net cost to the homeowner.
- There are many typical maintenance/remodeling projects that are prime opportunities to add significant energy efficiency upgrades such as re-siding where walls can be insulated and air-sealed much more easily during the re-siding. If this is not included in the major maintenance project, it may be many years before there is another such opportunity.
- Many trade contractors do not yet associate related energy improvements with the specific task for which they are providing repairs, and new networks of related home inspection and energy assessment must be developed.
- Home builders and trade contractors have increasingly adopted a quality system to implement “beyond-code” technical and construction practices encouraged by various efficiency and green programs. Adoption of a similar program by the remodeling industry could have a positive impact on a national scale energy retrofit effort.
- As residential remodelers and trade contractors move toward producing a high performing energy retrofit product, construction management tools and resources can accelerate this process.
- A systems approach to energy retrofits based on fundamental building science principles is another way in to deliver a high performing product at an affordable price to the homeowner with associated energy savings while also yielding profits for the remodeler and trade contractor.

#### **3.2 Meeting Topic**

The topic of this expert meeting was “Key Innovations for Adding Energy Efficiency to Maintenance/Remodeling Projects.” This topic was selected as an alternative approach to energy efficiency improvements that may, for instance, be based on an energy audit. This meeting was focused on major home repairs where the addition of energy efficiency approaches can significantly improve the energy performance of the home as the major repair is being completed. The premise was that many contractors are called on-site for maintenance and repair (such as a re-roofing, re-siding, HVAC replacement, etc), providing a unique opportunity for energy efficient upgrades, often at a marginal cost. According to Mike Rogers at GreenHomes

America, this is an opportune time to discuss energy efficiency upgrades.<sup>1</sup> For this expert meeting, the focus was specifically for re-roofing and the opportunities for adding energy efficiency during this major home repair activity.

### **3.3 Purpose and Objectives**

The meeting's two-fold purpose was to expand the BA program knowledge base and to focus the future research goals to address energy upgrades in existing homes. The BA program as a whole will use the information and insights obtained in this and similar meetings to facilitate adoption of energy efficient practices as part of remodeling activities. This meeting will provide a preliminary review of the expected benefits and performance requirements that can lead to key energy efficiency innovations in implementing common home repair and maintenance activities, as well as identify knowledge and technical gaps in achieving long-term implementation success.

Another objective of this meeting was to learn how trade contractors and remodelers typically approach larger maintenance projects, specifically in the re-roofing exercise, and to discover what resources are needed to facilitate the addition of energy efficiency upgrades to these projects. Particular emphasis was placed on the initial home assessment and follow-up inspection processes. Some of the items that were addressed to meet the objectives during the meeting included:

- Examining current approaches (both technical and consumer-related) to roofing maintenance projects
- Identifying additional steps or assessment procedures to the approach of these maintenance projects to add energy efficiency upgrades
- Identifying technical gaps and barriers needed to enable addition of energy efficiency measures to these projects.

---

<sup>1</sup> Mike Rogers "Business Strategy for Existing Homes" presentation. EEBA Conference 2011. Las Vegas, NM.

## 4 Expert Meeting Summary

The meeting agenda (see Appendix A for the full agenda) included:

- Presentation of a major home maintenance/remodeling activity e.g. roof replacement
- Outlining options for adding energy efficiency upgrades during the roof replacement
- Determining what is needed to integrate the roofing and energy upgrade activities:
  - Identify various approach(s) to adding energy efficiency upgrades to the primary project
  - Detail how trade partnering might work in either developing or implementing the roof replacement/energy upgrade based on the various approaches
  - Catalog the knowledge and technologies needed to facilitate this new approach
  - Identify the gaps and barriers to adding energy efficiency upgrades to a particular maintenance/remodeling project beyond the initial technical specifications.

### 4.1 Meeting Introduction

The meeting began with presentations to detail the premise of the meeting and help facilitate discussions. Following introductions, Joe Wiehagen from the NAHB Research Center began the meeting with an initial presentation summarizing the meeting topic (see Appendix B for the presentation). This presentation outlined the basic opportunity to add energy efficiency to a common maintenance/remodeling project, in this case, a roof replacement. It also detailed the search for key innovations within this context to determine the gaps and barriers.

### 4.2 Adding Energy Efficiency Upgrades to Attic from Exterior

This first presentation was the outline for the first half of the meeting discussion regarding adding energy efficiency to roof replacement. Thom Marston from the Energy Services Group identified energy-related problems that manifest themselves on the exterior of the home, and in particular, the roofing system problems that stem from attic energy problems. The presentation provided the relationship between common roofing problems with attic insulation and air-sealing deficiencies. The discussion focused on the opportunity to add specific energy efficiency upgrades during a roof replacement (see Appendix C for the presentation). In addition, the NAHB Research Center developed discussion points for this portion of the meeting, as detailed in Appendix D. The summary of this discussion is described below within the discussion point outline.

#### 4.2.1 *Roof Replacement: Adding Energy efficiency Upgrades at Attic from Exterior*

During the initial discussion, the experts discussed adding energy efficiency to a re-roofing project. The discussion included the following insights ordered by the discussion topics provided to the attendees.

Lost opportunity if business as usual:

- Re-roofing and large maintenance/remodeling projects are not frequent (one opportunity every 15 years). There is opportunity at this time to add energy efficiency upgrades in areas that may not be accessible again for a long time (e.g. top plate areas).

- A possibility is for the roofer to have the expertise to explain why a roof did not last. As part of this, the conversation with the homeowner needs to change to more fully explain the idea of what should come with a roof replacement.
- Numbers will not sell a house, emotions sell a house. As a result, homeowners make buying decisions based on emotion and use the numbers to justify. This is one way to discuss and sell energy upgrades.
- Ultimately, roofers need an interest from consumers to ask for energy upgrades.

Process for adding on energy efficiency upgrades to work:

- The process to add energy efficiency needs to include first upgrading the building envelope.
- The HVAC needs to be considered any time following any upgrade to the building envelope.
- Working back from an energy audit, is there information that can be developed for use by the roofer to be left with the homeowner?
- A specific standard energy upgrade list available to the roofer may help in consumer education/awareness (may be needed based on housing type, maybe as part of the utility data for a given location).

House assessment for energy efficiency upgrades added to re-roofing:

- Adding energy efficiency to re-roofing needs homeowner education including:
  - Value of incorporating energy efficiency into homes
  - Developing pull from consumer (the industry has developed plenty of push)
  - From utility point of view it is prudent to have certified auditors to assess the house.
- Some communities require energy audits on point of sale:
  - Beginning with the roof is not the place to start.
  - Homeowner education is needed and is easier as homeowners get more information. The utility bill is a great start for the conversation, can be used for marketing, and is a real opportunity for education.

Technical issues for roofer:

- One issue for the roofer is that adding energy efficiency does not have a consistent solution (one size doesn't fit all):
  - For example, clay-style roof is not replaced as a whole and therefore, this opportunity may not be available at all.
  - In addition, in many cases there is more roof repair than full replacement.
- Roofers doing energy upgrades is like pushing the chain uphill—it needs to get to the point that homeowners are asking for upgrades.
- There is more than one solution to every issue at varying costs:
  - One way to address this is to offer (1) good, (2) better, (3) best solutions in all scenarios that vary based on price.
  - Solutions for typical maintenance/remodeling projects are not just about energy, but also about replacement cost down the line.
  - How long the customer plans to stay in the house can change the best solution for them.

- In many cases, there are multi-dimensional issues that are very involved, including costs, technologies, whole-house considerations, etc.
- If a roofer sees issues with the house, by fixing one issue are we going to create other issues? In addition, are there other issues in the house (that should be addressed)?
- What ranges of products are available for the roofer to select from in performing upgrades and what training is necessary to use the products effectively?

Other contractors/partners needed:

- Working with industry to increase energy efficiency is not just a roofing thing or utility thing—everyone needs to work together.
- In addition to roofers, home inspectors and/or appraisers should also be educated regarding these issues to offer suggestions on ways to add energy efficiency to re-roofing.
- Relationship to BPI (or similar) professionals to verify improvements and safety.
- One issue with home inspectors is that there are not qualifications and they are typically not going to be hired again like a remodeler might.
- One way to simplify the need for additional education is to have a menu of solutions that various partners could use for education.
- Key utility company partnerships can be very successful when the utility provides homeowners with a guide on average energy use. This allows a homeowner to compare their energy use to the neighborhood average (like an ENERGY STAR label for energy use) to see if they use more or less than the average. In addition, this increases homeowner energy use awareness.
- The solutions for adding energy efficiency needs to be a holistic systems view that involves leaders in the industry and educated homeowners.
- There is an opportunity to get business from referrals.
- In many cases, the homeowners that need this the most are the ones that are not able to finance, so partnering is needed for financing projects.
- Roof replacements based on immediate need such as an insurance claim, do not often lend themselves to adding an expanded work scope to include energy efficiency.
- Market pull is needed, potentially driven by a public consumer education program.
- Utility partners in particular have/can:
  - Encourage energy upgrades during reroof project
  - Develop a ROI metric for various energy upgrades
  - Provide financing mechanisms.
- Opportunity extends well beyond roofer; other trades can benefit from this same approach.

Testing needed:

- The experts thought that the roofing contractor industry would benefit from a health/safety and energy efficiency training (something like BPI training):
  - Looking at the vast majority of roofing contractors, there is not currently a lot of training available.
  - This type of training is typically simple to get into.
  - The issues in adding energy efficiency to a re-roofing project starts and stops with education.

Implication on rest of house:

- Energy performance is the issue—the roofers need to start the discussion of performance with the homeowner. They need to help the homeowner understand how their house is performing now and how could perform in the future from upgrades (e.g. air sealing, insulation).
- Related changes that might have to go on from other improvements should be included:
  - For example, amount of combustion
  - Possible, but still gets back to performance.

#### **4.2.2 Gaps and Barriers: Technical Issues**

Energy performance:

- Performance is the key issue and discussion with the homeowner.
- Problem of understanding the energy audit and what to do with the information.
- Partnering is also very important:
  - This approach will not work with every homeowner however, it is only necessary to have success with a few.
  - A small group of people can then turn into a larger group ([http://www.cbsnews.com/8301-500523\\_162-57371195/swedish-sheep-herding-bunny-becomes-viral-hit/](http://www.cbsnews.com/8301-500523_162-57371195/swedish-sheep-herding-bunny-becomes-viral-hit/)).
- Consumer education is necessary to avoid “up-selling” complaints.
- Consumer-contractor relationship very important (credibility factor).
- Homeowner awareness is needed to push the market.
- Some type of consumer checklist may be helpful in developing market “pull.”
- Consumer access to an energy advisor/expert is minimal right now.
- Low energy use depends on the homeowner use as much as the house itself.
- Decision process to identify when a full assessment needs to be completed and when simple improvements can be generally implemented.

Building codes:

- There is also an opportunity to discuss performance through a comparison of building code that can enable a homeowner to rebuild home at current energy code levels (or ENERGY STAR levels).

Construction sequence:

- Insurance can be an issue, as in some cases the insurance company is in charge of the re-roofing project instead of the homeowner; therefore this can affect the construction sequence and motivation.

#### **4.3 Key Innovations – New Insulated Roof System**

The second half of the meeting began by a presentation from Ted Clifton from Zero-Energy Plans (see Appendix E for the presentation). This presentation detailed increasing the energy efficiency during a roof replacement by installing an insulated roof system. As with the first half of the meeting, the NAHB Research Center developed discussion points for this portion of the meeting as detailed in Appendix F. The summary of this discussion is detailed below organized within the second discussion point outline.



### **4.3.1 Roof Replacement: Key Innovations – New Insulated Roof System**

Lost opportunity:

- During roof replacement, there is an opportunity to move the insulation to the roof deck. The group primarily discussed using Structural Insulated Panel (SIP) Nailbase (a.k.a. retrofit panels) for this approach although there are other methods as well.
- There is opportunity during roof replacement to add energy efficiency in areas that may not be accessible again for a long time (e.g. top plate areas).

Roofer or remodeler for this approach:

- Either a roofer or remodeler could do this work, however, it may be out of the realm for many roofers.
- As far as sales, many roofers have a sales team to sell roofing that would need training to be able to discuss insulating the roof deck to create a conditioned attic.
- Qualified leads are needed for this type of roof replacement and the issue-solution discussion can work well to discuss this upgrade with a homeowner.
  - Pain factor – leak, frost, ice dam
  - Have solution – up-sell to fix pain (can now up-sell).
- Even with knowledgeable roofers and remodelers capable of including energy upgrades in typical work scopes, a better understanding of the issues and solutions by the consumer as the market driver, is necessary.
- Roofers and remodelers can use this technique to take small opportunities and turn them into bigger ones (potential new profit center for roofer).
- In addition, homeowners need to expect more. With any project, homeowners should ask—what else can we do?

Design issue:

- With roof replacement using SIP Nailbase/Retrofit Panels, there are other design requirements such as redoing fascia and air sealing.
- A roof replacement using these panels works well with simple roof designs. For example, a typical 1970's house is a perfect house for SIP Nailbase/Retrofit Panels.

Technical issues for roofer/remodeler

- Roofers will be able to install insulation over sheathing or the SIP Nailbase/Retrofit Panel—no specific technology limitation.
- Roof insulation technology and integration will require other exterior work i.e. gutters, fascia, etc.
- Any roofer can do air sealing; however, they may want to partner with an existing company already performing air sealing.
- Not every roofer/remodeler will want or be able to do this type of roof replacement. The select few that do will have a profit center from this work.
- The things to consider when adding energy efficiency to re-roofing (as well as HVAC, siding, etc):
  - Become front runner
  - Provide more information to homeowners.

- There are other technologies to include in adding energy efficiency to roof replacement including cool roofs, ventilation, etc.

Implication on rest of house:

- The major whole-house implications for replacing a roof with the SIP Nailbase/Retrofit Panels are:
  - Should the insulation in the attic floor be removed as part of the project?
  - Based on the roof insulation and any air-sealing improvements, are other testing or equipment requirements necessary to ensure safe operation of the home?

#### **4.3.2 Gaps and Barriers**

Products and standard design details:

- One large gap with SIP Nailbase/Retrofit Panels roof replacement is the need for standard details.
  - Stay in standard dimensions for fascia, as this will simplify the install.
  - Currently used primarily in commercial, not typical in residential roof upgrades.
- Assessment tools to determine if the roof can accept insulation and how to implement based on house features.

Installation:

- One installation barrier is the fact that roofers do not currently use subcontractors and they may need to partner with air sealing company to complete this work. Therefore, the air sealing may limit some roofers with this approach.

Energy performance:

- SIP Nailbase/Retrofit Panel upgrades for roof replacements allow energy performance improvements along with easy installation.

Building codes:

- A possible code barrier is that a roofer needs to work with local code officials to ensure that this method is appropriate for approval.
- With the use of thicker foam products, certain fire protection issues may arise.

Construction sequence:

- The only gap with the construction sequence is the fact that air sealing may be performed by another trade and that typically roofers do not use subcontractors.

Climate:

- Climate is an issue, specifically the amount of insulation (thickness of the panel) and if the existing insulation in the attic should stay or be removed.
- Ultimately, it would be helpful to have a matrix of climate zones detailing these items.
  - Simple rules of thumb
  - Safe amount of foam (thickness of panel)
  - Remove/keep existing attic insulation.

Incentives:

- Incentives would help this type of work, particularly financing options
  - Something like PACE
  - Local initiatives
  - Investment bonds.
- Incentives should come from two directions including local incentives as well as support from state/federal.
- Improving energy efficiency of houses comes from various places; homeowner and utility are two opportunities.
- Brochure from authority is needed to detail tradeoffs:
  - Good, better, best solutions
  - Resources from a third-party.
- Make a business case outlining the monetary benefits of energy efficiency including the impact of future utility rates.
- Improved messaging that upgrading the energy efficiency of a house is safe investment; compare rate of return with other types of investments (e.g. stock market).
- Opportunity to discuss “payback” for roofing – not a typical approach and presents an opportunity for a new perspective for roof replacement projects.
- “Pain factor” – drives some consumer decisions to increase the efficiency of the home
- Third party assessment may add credibility to the overall approach.

#### **4.4 Attendees**

Attendees included leading experts in the remodeling and energy performance remodeling industries and building industry professionals in construction protocols and procedures. The attendees of the meeting are listed in Appendix G.

#### **4.5 Next Steps**

The expert meeting concluded with a facilitated discussion on overarching methodologies of including energy efficiency upgrades in a typical maintenance/remodeling project that may apply to any similar project regardless of its scale and approach. The experts believed that adding energy efficiency to typical maintenance/remodeling projects, specifically roof replacement, is an opportunity for roofers that is possible and achievable. This can result not only in additional profit for the remodeler, but cost savings and better long-term performance for the homeowner. This discussion also acknowledged that this approach can be used for other major maintenance/remodeling projects to address needs within the energy retrofit industry.

The lessons learned from this meeting will be used by the NAHB Research Center Industry Partnership as well as the STC for Implementation Tools to refine its retrofit research agenda and objectives as they relate to energy retrofits. In addition, the results will support the BA teams’ work in implementing energy efficiency into remodeling projects.

The next step will be to work with the remodeler roofing industry and energy rater/audit company partners to identify a potential existing home project(s) that can include energy efficiency upgrades to the selected re-roofing project. The intent will be to document a successful reroofing project that enhances energy efficiency, as well as successfully meets the original intent of the project of roof replacement. The result of this test project will include any

technical details necessary to ensure energy efficiency such as air sealing, insulation, etc. If this approach proves successful with roofing contractors and remodelers, there is potential to work on additional maintenance/remodeling projects, such as re-siding, to take a similar approach to increasing energy efficiency in existing homes.

## References

- Case, B (2011). “Challenges in Bringing Energy Efficiency to Existing Single Family Housing Stock.” Presented at the U.S. Department of Energy Building America Residential Energy Efficiency Stakeholder's Meeting. Atlanta, GA. March 16-18, 2011:  
[http://apps1.eere.energy.gov/buildings/publications/pdfs/building\\_america/ns/eemtg032011\\_a22\\_challenges\\_single\\_family.pdf](http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/ns/eemtg032011_a22_challenges_single_family.pdf)
- Fisette, P (2011). “Preventing Ice Dams” Building and Construction Technology, University Of Massachusetts. Amherst, MA. 2011, web publication, <http://bct.eco.umass.edu/publications/by-title/preventing-ice-dams/>.
- Fisette, P (2008). “Reroofing and Residing to Save Energy.” *NAHI Journal*. May/June 2008.
- Joint Center for Housing Studies of Harvard University (2011). “A New Decade of Growth for Remodeling, Improving America’s Housing” Harvard Graduate School of Design. Cambridge, MA. Accessed March 2012:  
[http://www.jchs.harvard.edu/sites/jchs.harvard.edu/files/2011\\_remodeling\\_color\\_version.pdf](http://www.jchs.harvard.edu/sites/jchs.harvard.edu/files/2011_remodeling_color_version.pdf).
- Larson, T, Hendricks, L, Huelman, P, Revisions by Richard Stone (2009). *Ice Dams*. Accessed March 2012:  
<http://www.extension.umn.edu/distribution/housingandclothing/dk1068.html#preventing>).  
University of Minnesota, Extension Service. St. Paul, MN.
- Rodgers, M (2011). “Perspective from the Field: Scaling Home Energy-Efficiency Retrofits.” Presented at the U.S. Department of Energy (DOE) Building America Residential Energy Efficiency Stakeholder's Meeting. Atlanta, GA. March 16-18, 2011:  
[http://apps1.eere.energy.gov/buildings/publications/pdfs/building\\_america/ns/eemtg032011\\_a12\\_scaling\\_retrofits.pdf](http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/ns/eemtg032011_a12_scaling_retrofits.pdf)).

## Appendix A: Expert Meeting Agenda

### Key Innovations for Adding Energy Efficiency to Maintenance Projects

#### *Expert Meeting Agenda*

**Venue:** International Builders' Show (IBS) Orlando, FL

**Location:** Orange County Convention Center

**Room Assignment:** West 102 B

**Date:** Wednesday, February 8, 2012

**Time:** 1:00pm – 4:00pm

- |                  |   |
|------------------|---|
| 1:00 – 1:15 p.m. | <b>Welcome &amp; introductions</b>  |
| 1:15 – 1:45 p.m. | <b>Review of background materials</b>   |
| 1:45 – 2:30 p.m. | <b>Present typical larger home maintenance project (i.e. Re-roofing)<br/>Outline options to add energy efficiency upgrades to the project</b> |
| 2:30 – 2:45 p.m. | <b>Break</b>  |
| 2:45 – 3:45 p.m. | <b>Identify key innovations to adding energy efficiency upgrades to the<br/>maintenance project</b>   |
| 3:45 – 4:00 p.m. | <b>Wrap-up discussion of barriers, gaps, next steps, and Q&amp;A</b>  |




## Appendix B: Introduction Presentation – NAHB Research Center




# Key Innovations to Adding Energy Efficiency to Major Household Maintenance Projects

Building America Expert Meeting  
February 8, 2012



## Major Maintenance Projects



- Significant work necessary
- Already beyond the DIY option
- Likely a rare occurrence in lifetime of homeownership (once, maybe twice)
- Presents unique upgrade improvements to related aspects

4



## Innovation Opportunity Link Maintenance Projects to Energy Efficiency



- Maintenance projects result from an energy feature deficiency
- Maintenance projects present access to house features not typically available
- Additional energy upgrades that piggyback on a project can lower costs

5



## Search for Key Innovations


- Integrating Knowledge and Experience of:
  - Trade Contractors
  - General Contractors
  - Energy Audit Companies
  - Manufacturers/Suppliers
  - State/Utility Programs
  - Others

6



**Example Case Analysis:  
Roof Replacement**

- General 20 – 25 year lifetime
- Undertaken to avoid future problems
- Undertaken as result of problems
- Often result in additional repairs to parts of roof system



7

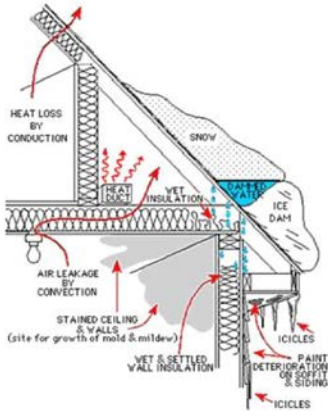

**Energy Efficiency  
Assessment**

- Skills needed to identify problems stemming from air leakage and insulation problems
- Identify repairs/upgrades that can be corrected from the outside/Outside In
- Show value in improving energy features at a lower net cost and disruption to the homeowner

8

NAHB RESEARCH CENTER

## The Result Outside is All About the Inside



HEAT LOSS BY CONDUCTION

SNOW

ICE DAM

WET INSULATION

AIR LEAKAGE BY CONVECTION

STAINED CEILING & WALLS (site for growth of mold & mildew)

WET & SETTLED WALL INSULATION

ICICLES

ICICLES

ICICLES

DETERIORATION OF SOFFIT & SIDING

PAINT

<http://www.extension.umn.edu/distribution/housingandclothing/dk1068.html#preventing>

9

NAHB RESEARCH CENTER

## Current Situation

- Expertise is vital yet disassociated
- Project timing is often out-of-sync
- Knowledge and use of specific products not common across expertise
- Value is difficult to communicate to the consumer


**Needed: Key Innovations to Integrate Energy Upgrades into Typical Maintenance Projects**

10

## Appendix C: Adding Energy Efficiency to Roof Replacement – Energy Services Group

**Energy Efficiency and  
Roofing Replacement**


Building America Expert Meeting  
February 8, 2012  
Thom Marston, Energy Services Group



**Signs of Moisture Issues**

Snow melting on our roofs can predict where hot air and moisture cause roofs to rot.

These 2 roofs have no snow melt pattern. These pictures were taken at sunrise reducing the effect the sun would have at melting the light dusting of snow. This snow fall occurred on a windless night.



## Indications of structural and energy issues



These townhomes may need new plywood at the party wall to correct the failure of old FRT plywood. In addition, the snow melt at the party wall indicates future moisture damage.

## Indicators of thermal bypass

The lower roof of this house is connected to floor joist cavity between floors.



A similar condition exists in this Dutch colonial. When you remove the roof decking and look into the floor cavities, then you will see the path that warm and humid air will travel to reach the snow on the roof.



## Common chimney culprit

We seldom see such a clear pattern as this. A visit inside will confirm that the chimney has frame walls that surround the flue to form a framing void. The warm air in the void is melting the snow because the rafter insulation is not covered with an airtight material.



## Common dormer culprit

The typical Cape Cod has cavities that allow the floor joists and the knee walls to pump moisture onto the backside of the roof. The spaces between the dormers are accessible, but the area in front of the dormer is not accessible from inside the attic. Remove the roof and all areas can be airtight and insulated correctly.



## Locating trouble spots

This attic is more challenging because of the turned gable. There is an upper roof cavity on the left side above the collar rafter that is causing snow melt.



## New homes with indications of thermal bypass

This new contemporary home has many roof lines that cause the snow to melt. Due to the size, we may have a heating system in the attic. It gives off heat at the air handler and the ducts loose energy through leakage as well.



## Reducing roof snow loads....

This commercial building's lower roof is performing well. The floor framing is isolated from the roof and the lower floor ceiling is drywalled. The upper floor ceiling is a suspended grid ceiling with ducts between the tiles and the building insulation. This practice is now outlawed in the Commercial Energy Code.



The pictures were taken by Ed Minch of Energy Services Group one snowy morning while walking through Chestertown Maryland.

Please contact us at [ed@energysvc.com](mailto:ed@energysvc.com) and [thom@energysvc.com](mailto:thom@energysvc.com) or call us at 800.908.7000



## Appendix D: Expert Meeting Discussion Points – Adding Energy Efficiency to Roof Replacement



### Key Innovations for Adding Energy Efficiency to Maintenance Projects

#### *Expert Meeting Discussion Prods*

#### **Roof Replacement: *adding energy efficiency upgrades at attic from exterior***

- Lost opportunity if business as usual
- Typical re-roofing approach independent of other improvements
- Process for adding on energy efficiency upgrades to work
- House assessment for energy efficiency upgrades added to re-roofing
- Technical issues for roofer
- Other contractors needed
- Testing needed
- Implication on rest of house

#### **Gaps & Barriers: *technical issues***

- Products
- Installation
- Energy performance
- Building codes
- Construction sequence

## Appendix E: Roof Deck Energy Upgrade – Zero-Energy Plans

### Retro-fit SIPS

By Ted L. Clifton  
Zero-EnergyPlans.com



1

### Goals of this presentation:

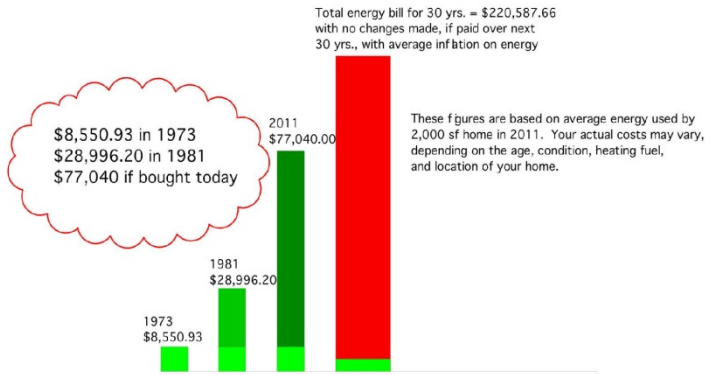
- Introduce the Roofing Industry to Retro-fit SIPS
- Introduce Siding and Window Industry to Retro-fit SIPS
- Solve Insulation and Air Sealing problems
- Avoid lost opportunities for Energy Efficiency

2



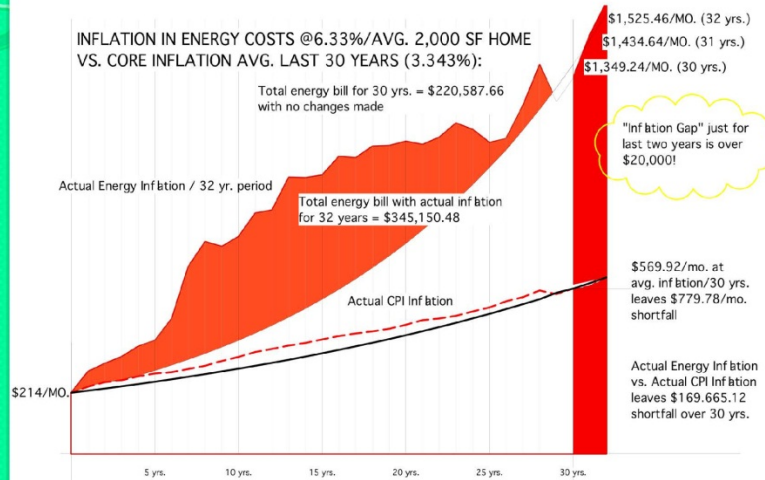
## What if you bought all you energy at once?

HOW MUCH WOULD YOUR LAST 30 YEARS WORTH OF HOME ENERGY HAVE COST?



3

## How much will your Future Energy Cost?



4

## Retro-fit SIPS are part of the Whole House Approach

- Whole House Approach
- Homes and buildings = 39% of total energy
- Homes use about half = 19% of our total energy
- We can cut that by 2/3 or more!
- Aging housing stock needs help!

5

## The typical 1960s house:

- 2x4 walls, R-11 insulation, or perhaps no insulation at all!
- R-19 ceiling insulation, R-19 floor insulation, if any!
- Aluminum single-pane windows!



6

## Why are we doing this?



7

## Why focus on these homes?

- They use between two and three times the energy of today's homes.
- They account for 90% of home energy use.
- They can achieve the greatest benefits
- They could reduce US energy use by about 17%!

8



9

How do the “Other Guys” do it?

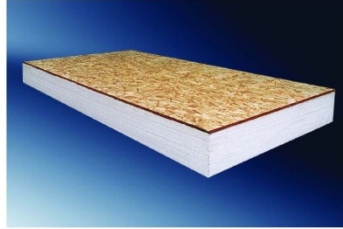
They spend **WAY** too much money!



10

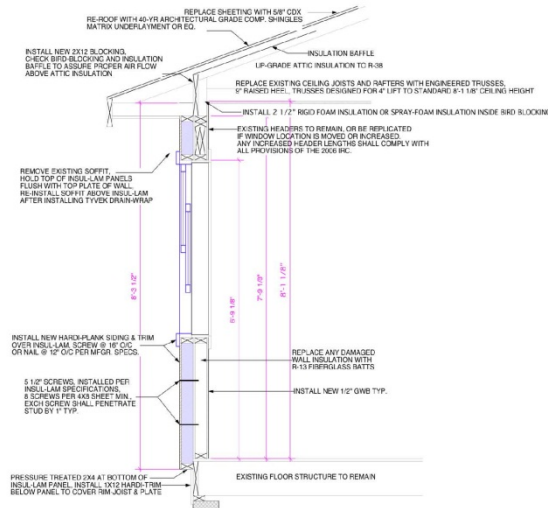
## What is an Insul-lam Panel?

- “half a SIPS”
- OSB on one side, laminated to EPS foam insulation on the other.
- R-value of about 3.85 per inch, or R-14.4 for a 3 1/2” wall panel, R-38 for a 10” roof panel



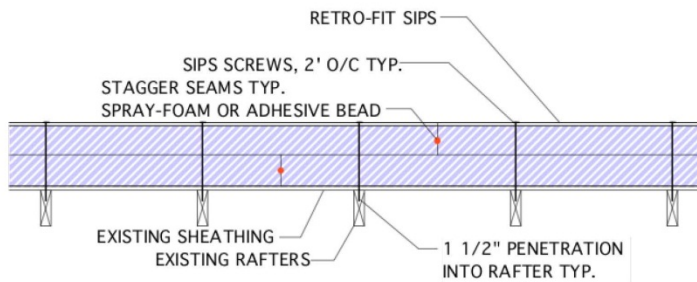
11

- We have a full set of Construction Details:



12

- Simple Roof Installation Details:



13



14

## Caulked and Ready



15

## Insul-Lam Installation



16

## New House? Looks like it!



17

## Questions????



[www.zero-energyplans.com](http://www.zero-energyplans.com)

Ted L. Clifton

18



## Appendix F: Expert Meeting Discussion Points – Insulated Roof Deck



### Key Innovations for Adding Energy Efficiency to Maintenance Projects

#### *Expert Meeting Discussion Topics*

##### **Roof Replacement: *key innovations – new insulated roof system***

- Lost opportunity
- Roofer or remodeler for this approach
- Design issue
- Technical issues for roofer/remodeler
- Manufacturer role/involvement
- Testing needed
- Implication on rest of house

##### **Gaps & Barriers**

- Products and standard design details
- Installation
- Energy performance
- Building codes
- Construction sequence
- Climate
- Needed steps prior to considering solution

## Appendix G: Expert Meeting Attendees

**Table 1. Expert Meeting Attendees**

Name	Company	Description
Matt Belcher	Verdatek Solutions	Manufacturer, Remodeler, & Builder
Ted Clifton	Zero-Energy Plans & Clifton View Homes (CVH)	Remodeler & Builder
Tim Ellis	T.W. Ellis	Remodeler
Don Ferrier	Ferrier Companies	Remodeler & Builder
Mark Graham	National Roofer Contractor Association (NRCA)	Association & Technical roofing expert
Kim Hibbs	Hibbs Homes	Builder
Pat Huelman	University of Minnesota	Energy expert & Building America (BA) team
Daniel Kauffman	Truveon	Manufacturer
Sid Koltun	Laclede Gas	Gas Utility
Travis Laminack	Ferrier Companies	Remodeler & Builder
Thom Marston	Energy Services Group	Energy Rater & Consultant
Stacey Rothgeb	NREL	Energy expert & BA technical monitor
Ray Tonjes	Ray Tonjes Builder	Remodeler & Builder
Sam Taylor	Consultant	Energy expert
Joseph Wiehagen	NAHB Research Center	BA team
Amber Wood	NAHB Research Center	BA team

*buildingamerica.gov*

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

DOE/GO-102012-3600 • September 2012

Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 10% post-consumer waste.