

Building America Affordable High-Performance Home Competition

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BACKGROUND

The U.S. Department of Energy invests in high-performance new and existing home innovations through its world-class research program called Building America. The key goals for this program are to:

- support market transformation of new construction to zero net-energy ready homes that are so efficient (e.g., about 50% above the latest code) that a small renewable energy system can offset most or all annual energy consumption, and
- development of a robust market for high-performance home retrofits that save 20-30% or more of total energy consumption.

There is a four-prong strategy for achieving these goals:

1. Develop advanced technologies and practices that deliver cost-effective high-performance;
2. Prove performance with whole-house new and retrofit packages of advanced technologies and practices;
3. Provide guidance and tools needed to apply and refine proven innovations; and
4. Enable innovations by removing infrastructure barriers to market transformation.

After tracking Building America accomplishments since the program's inception, one infrastructure need that has emerged is insufficient building science education to ensure an adequate supply of skilled professionals who can apply proven innovations and understand the value of high-performance homes. DOE has begun to address this issue with a Building America Building Science Education Summit on November 7, 2012 at the National Association of Home Builders Research Center. On November 8, this same group of participants worked on a potential 'low-hanging fruit' opportunity for enhancing the presence of building science in university and college architectural, engineering, and construction programs by setting up an affordable high-performance home competition. The intent of this action is to complement the very successful Solar Decathlon competition that encourages bleeding edge technology and design solutions with a more practical competition that encourages integration of proven building science technologies and practices in actual affordable housing projects that will cost less to administer and can be implemented more broadly.

This facilitated meeting brought together over 30 leaders in building science training, education, research, program implementation, and leadership from across the country to develop a strategic plan for this competition. This final report documents the results of this meeting after providing some broader organization and structure.

SUMMIT PARTICIPANTS

Facilitators:

Sam Rashkin, Chief Architect, DOE Building Technologies Office

Sarah Mabbitt, Energetics

Name	Position	Organization
Building Science Educators		
Ben Bigelow	Professor of Construction Science	Texas A&M University
Tony Grahme	Professor of Green Building Technology	Univ. of Georgia
Patrick Huelman	Professor of Biosystems Engineering	Univ. of Minnesota
Joe Laquatra	Professor of Design and Env. Analysis /Department Extension Leader	Cornell University
Arn McIntyre	Director, Energy Center	Ferris State Univ.
Mike Mazor	Adjunct Associate Professor	Michigan State University
Robert Reed	Director, Midwest Energy Efficiency Research Consortium (MEERC)	Univ. of Missouri
Georg Reichard	Professor of Building Construction	Virginia Tech
Bill Rose	Research Architect, Building Research Council	Univ. of Illinois at Urbana-Champaign
Building Science Researchers		
Michael Baechler	Senior Program Manager	PNNL
Pam Cole	Scientist	PNNL
Tom Kenney	Senior Manager	NAHB Research Center
Janet McIlvaine	Senior Research Analyst	FSEC
Cheryn Metzger	BA Research Coordinator	NREL
Stacy Rothgeb	BA Research Coordinator	NREL
Building Science Organizations/Product Manufacturers		
Keith Aldridge	Exec. Director	Advanced Energy Corp.
James Brew	Principal	Rocky Mountain Institute
Amy Fazio	CEO	ACI
Jessica Hunter	Principal	Rocky Mountain Institute
Alexis Karolides	Principal	Rocky Mountain Institute
Brian Lieburn	Senior Advisor – Residential	DOW Building Solutions
Chris Little	Senior Advisor - Residential	BASF
Sydney Roberts	Home Services Program Man.	Southface
Craig Savage	Director	Building Media, Inc.
Karen Thull	Exec. Director	EEBA
Paul Totten	Senior Project Manager	SGH /NIBS/BETEC/Catholic University of America
Linda Wigington	Director Deep Energy Retrofit Initiatives	ACI
Government Programs Promoting Building Science		
Elizabeth Cocke	Director Afford. Hsg. Research & Tech. Div.	HUD
Eric Werling	Bldg. America Coordinator	DOE
Housing Industry Leaders		
CR Herro	Environmental Manager	Meritage Homes
John Sader	President	Sader Power Enterprises
Building Science Advocates		
Rose Grant	Program Director	State Farm Insurance
Sam Taylor	Building Science consultant	Sam Taylor

KEY RESULTS

Proposed Framework

An affordable high-performance home competition would complement DOE's highly successful Solar Decathlon during its off-year. As an alternative to the Solar Decathlon forward-looking solutions and significant costs for construction and shipping of completed designs, the Affordable High-Performance Home competition would emphasize practical 'shovel-ready' designs and substantially reduce participation costs by only requiring design and technical documents. Ideally, there will be affordable housing sponsors committed to constructing the winning projects. A cornerstone of this competition would be to provide training that gives students a solid building science foundation.

Proposed Submittal Requirements

This competition would entail a comprehensive package of technical specifications, design renderings, analyses, performance metrics, and marketing information that ensure building science is fully integrated in the students' curriculum.

Prize Options

There is an impressive array of prize options that can attract students, professors, and universities, including many low or no-cost incentives. These are critical to attract participation at all levels.

Actions

With the Solar Decathlon taking place in October 2013, the affordable high-performance home competition should be scheduled for the off year in fall of 2014. That means a lot of actions need to take place so schools are ready to start work in fall of 2013.

Follow-up Plan

The key actions that need to move forward include completing the Affordable High-Performance Home Competition Plan; surveying Education Summit participants for related high-performance home competitions, setting up the NAHB Research Center as the competition manager with Building America funding, and establishing a competition steering committee.

PROPOSED FRAMEWORK

The following comments include feedback from the meeting organized into key topics with some details added for completeness.

Concept

- To complement rather than compete with the highly successful Solar Decathlon, hold during the off-year of that competition
- Competition only requires design and technical documents for affordable high-performance homes with sponsors recruited to construct the winning designs
- Hold five concurrent regional competitions targeting climate-appropriate designs for individual or paired Building America climate zones (Cold/Very Cold; Mixed-Humid; Hot-Humid; Hot-Dry/Mixed Dry; and Marine)
- Finalists from the regional competitions would compete for a national competition prize
- Participating schools may submit designs for climate-zones outside of their actual location
- Extensive building science education would be the emphasis during the off-year.
- Alternative approaches suggested for the competition include:
 - Implement one national competition
 - Provide only the design parameters
 - Provide a reference floor plan for competitors to adapt and improve upon based on climate and design factors
 - Implement a ‘science fair’ model with standard problem sets addressing specific high-performance home issues to solve (“housing innovation fair”)
 - Open to various levels (e.g., K-12; two-year degree, four year degree, graduate)

Communications and Outreach

- Effectively attract large media involvement
- Obtain sponsorships from corporations and foundations
- Conduct outreach to student organizations

Implementation Ideas

- Utilize test facilities to construct innovative components
- Employ a Skills USA (www.skillsusa.org) approach to require competitors to show prerequisite skills/aptitude by solving a given problem
- Provide opportunities for employers to recruit students
- Develop a scoring rubric with weighted elements
- Start with a pilot competition to work out details

Competition Parameters

- Set up a cost cap per house (e.g., total or per square foot)
- Establish clear design requirements (e.g., size and/ or function, location, price point, etc.)

Avoid overly prescriptive elements

Planning

- Survey existing design competition concepts for successes and lessons learned and ensure the competition addresses critical gaps
- Define unique purposes of the proposed competition
- Determine cost budget, energy budget, and other metrics for measuring performance
- Determine the desired outcome for the competition (e.g., influencing building science curriculum)
- Account for the time and resources required by each university/college to participate

Training/Education

- Develop and curate model curriculum for schools to adopt/expand
- Train trainers first to serve as competition mentors
- Determine prerequisite building science courses for competitors
- Offer prerequisite courses online or as course electives

SUGGESTIONS FOR SUBMITTAL REQUIREMENTS/SCORING CRITERIA

Suggested Submittal Requirements	Suggested Measurement Test
Technical Specifications	
Challenge Home Compliance <ul style="list-style-type: none"> • Thermal Enclosure • HVAC Quality Installation • Water Management • Indoor Air Quality • Solar Ready • Water Efficiency • Disaster Resistance 	Checklists: ENERGY STAR for Homes v3 <ul style="list-style-type: none"> • Thermal Enclosure • HVAC Quality Installation • Water Management Challenge Home EPA Indoor airPLUS EPA Renewable Energy Ready Home EPA Water Sense IBHS Fortified Home
Complete Construction Documents	Working Drawings/Specifications
Control Systems	Narrative
Design	
Architecture	Renderings/Narrative
Site (orientation, views, drainage, exterior space)	Site Plan/Narrative
Layout	Floor Plan/Narrative
Lighting	Lighting Design Plan/Narrative
Scalability (availability of materials and equipment)	Narrative
Analysis	
Construction Cost Analysis	Cost Estimate Take-Off
Ownership Cost Analysis	PITI plus Energy and Maintenance
Energy Consumption Analysis	HERS Software
HVAC System Design (Equip., Ducts, and Terminal Sizing)	ACCA Manual J, S, D, and T
Hydro-Thermal Analysis	WUFI (for advanced students)
Energy Code	Checklist
Health and Safety	Checklist
Performance Metrics	
KW Peak Load	HERS Software Results
KWh/Therm Annual Load	HERS Software Results
Air Tightness	Estimate
HVAC Distribution Efficiency	Estimate
Durability	Narrative
Constructability (construction sequencing)	Narrative
Marketing Education	
Marketing Materials	Narrative
User Interface	Proposed Home Owner Manual
Presentation Communication Skills	Written/Verbal Content

SUGGESTED COMPETITION PRIZE OPTIONS

Student Participation Incentives

- Commitment to construct winning design by sponsor (e.g., Habitat for Humanity, local Community Housing organization)
- Internship or career opportunity
- Scholarship (possibly offered by school)
- Career Fair (access to potential employers)
- Attendance at key conferences for training (e.g., ACI, EEBA)
- Building Science Certificate upon completion/test
- Media exposure (plan books, print, trade journals, TV, Chronicle of Higher Education)
- Cash Prize
- Physical Award (trophy, medal, banner to be hung at school, certificate, graduation cords)
- Interaction between students and alumni networks
- Access to mentors/leaders in the housing industry
- High level federal government recognition/banquet (e.g., White House, DOE Secretary level)
- Study abroad/exchange program
- In-kind sponsored materials (e.g., iPads, CAD software, etc.)
- Competitor SWAG
- Letter of recommendation for each participant from senior federal official

Instructor Participation Incentives

- Access to desirable conference (e.g., ACI, EEBA)
- Media exposure to class (plan books, print, trade journals, TV, Chronicle of Higher Education)
- Instructor recognition
- Program recognition on Building America and other web sites
- Visibility with leading builders and judges

University Participation Incentives

- Featured location for competition event the following year
- Media recognition for university program (print, trade journals, TV, Chronicle of Higher Education)
- DOE publicity package (recognition of university program)
- Enhanced university resume for attracting 'best' students
- Access to student organizations (on-campus and associated with industry groups – NAHB, ASHRAE)
- Opportunity to start student chapters associated with the competition
- Opportunity to promote program linked directly to jobs

SUGGESTED KEY ACTIONS

Key Actions
Survey Existing Competitions
Develop a list of related competitions
Cross-reference existing competitions w/Building Science Education Assets [see Education Summit]
Identify Building Science Education assets to support the competition (e.g., NTER, etc.)
Planning
Define 'Building Science' [see Building Science Education Roadmap]
Define competition objectives and scope of work and how they uniquely fill gap in education
Estimate a realistic cost and timeline for scope of work
Identify prospective advisors/champions at schools of architecture, engineering, and construction
Identify list of prospective building science expert mentors
Establish a lead organization to oversee the competition
Form a competition steering committee with governance structure
Name the competition and develop a logo
Secure funding to design and run the competition
Identify preferred list of prizes/incentives
Identify partners
Training
Develop a model syllabus for pre-requisite building science classes (e.g., Building Science 101 Model Curriculum)
Curate an on-line building science education program or curriculum as a model and back-up for schools that do not have courses
Develop building science mentors for participating schools
Develop and provide on-line and on-site orientation, training and educational support for participating schools
Implementation
Form dedicated student chapters associated with trade associations
Secure preferred prizes/incentives
Provide a business budget template that outlines costs for resources and levels of commitment
Steering committee develops details for competition evaluation criteria and scoring rubric
Create pre- and post-competition tests/qualifications that ensure building science knowledge
Initiate pilot competition[s]
Outreach
Prepare a school business case/prospectus for the competition
Promote event to schools
Identify sponsors (e.g., manufacturers, associations, other high-performance home stakeholders)
Prepare a communication plan
Enlist industry representatives and building science experts to serve as advisors/mentors
Identify prospective schools
Recruit participating schools/programs
Develop a web site

PROPOSED FOLLOW-UP PLAN

Action	Lead	When
Set up NAHB Research Center as Competition Manager <ul style="list-style-type: none"> Work with Building America program to secure funding for NAHB-RC management of competition. 	BA	4/13
Survey Existing High-Performance Home Competitions: <ul style="list-style-type: none"> Survey summit participants for any high-performance home competitions Summarize findings and verify the proposed competition fills a critical gap 	BA	2/13
Establish a Competition Steering Committee: <ul style="list-style-type: none"> Survey Education Summit participants for potential Steering Committee members Select Steering Committee members Form an advisory board (to mentor competitors) Set up initial Steering Committee meeting to review, comment and finalize the competition plan Develop name for competition Prepare implementation plan for launching competition fall of 2013 Ongoing Steering Committee meetings to review progress/refine plan/make decisions 	NAHBRC	5/13