BTO Peer Review 2017

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

Building America Program Overview

ERIC WERLING
Building America Program Director
Building Technology Office

Building America

Vision	Improved homes for Americans, that **cut bills in half**, improve **health/comfort**, & increase **jobs/profits** for housing industry based on **better home performance/value**
Goals	Demonstrate by 2020 integrated building & HVAC technologies that affordably **reduce EUI 60% for new homes** and **40% for existing homes** in all U.S. climates
Strategy	Develop/Demonstrate/Disseminate building science & engineering **best practices** that **improve home performance** and **lower risks**, market tested through **industry partnership**

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The Residential Integration Program accelerates energy improvements in existing and new residential buildings by reducing technical and market barriers to spur investment and achieve high performance homes.

Dec. 2015

External Influences: DOE budget, Construction industry, Energy prices, Real estate market, Market incentives, State/local policies, Regulation

Objectives	Activities / Partners	Outputs	Short Term Outcome	Mid-Term Outcome	Long Term Outcome
Demonstrate & integrate energy efficient technologies & practices in representative homes	Competitive R&D funding focused on demo, testing & validation by Building America & national lab researchers in field homes	Space conditioning, water heating & IAQ focused Building America upgrade packages & techniques for existing & new homes across climates	Innovator building professionals equipped with validated energy saving solutions for integrating highly energy efficient tech or practices into homes	Leading building professionals improve or construct high performance homes above model energy codes	The building industry regularly constructs high performance homes that are ready for renewable energy systems or significantly improves the energy efficiency of existing homes across climates.
	Resources development with national labs for building prof. & service providers	Guidance for energy savings beyond recent building energy codes & industry standards for stakeholders	Industry standard orgs. & voluntary programs equipped with validated technical specs & guidelines to make homes highly efficient	Industry standard orgs adopt technical specs to accelerate new tech & practices in building energy codes	
Prove energy saving solutions & programmatic designs on a national scale with market partners	Support business model demo to upgrade or construct high perf. homes with market partners across climates	Best practice online Better Buildings & Buildings America Solution Centers		Energy efficiency programs facilitate market demand for energy efficiency & foster [illegible]alue energy	
	Outreach to st[illegible] national scale adoption of en[illegible] solutions in co[illegible] transactions.	Demonstrated home upgrades [illegible]		[illegible]sionals install [illegible] saving solutions in the broader market	Homeowners are motivated to invest in more energy efficient homes spurred by increased value in the residential market.
Accelerate market adoption by increasing understanding of effective energy saving solutions	Tool development & demo of the value of energy efficiency in the market with market partners	Targeted campaigns to propel adoption of low cost home upgrade improvements	increase scale of energy efficiency investments		
	Educational support to promote quality workforce	Home Energy Score tool	Wide array of industry stakeholders & building professionals aware of strategies to increase energy efficiency	Industry stakeholders widely promote value of energy efficiency in products, services, & typical market transactions with homeowners	
		Building science curriculum, student competitions & workforce development			

This is the RBI Program Logic Model, with Building America focus areas highlighted

Impact					
	40% savings in existing homes demo'd 60% savings in new homes demo'd 10% savings thru individual measures	Proved in 1 million existing homes & 50K ZER new homes	Market Partnerships reach 90% of homes 5% savings thru individual measures with partners	Reduce the energy used for space conditioning & water heating in single family homes by 40% by 2025 from 2010 levels	Reduce avg. EUI in all bldgs. 30% by 2030

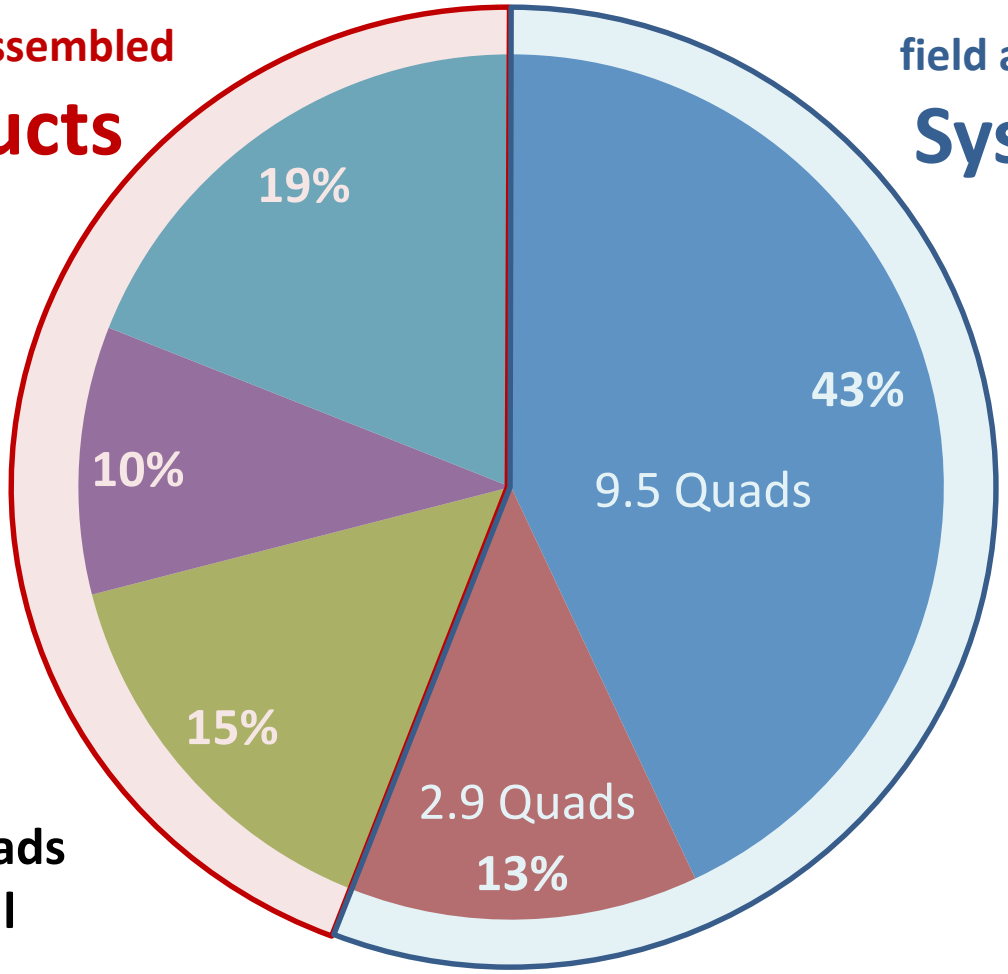
Building America Aims to ***Cut Energy Use of U.S. Homes in Half*** by Helping Industry Improve "Integrated" (Field Assembled) Systems

factory assembled

Products

field assembled

Systems



- Comfort (Envelope & HVAC)
- Water Heating
- Other Appliances
- Lighting
- Misc. End Uses

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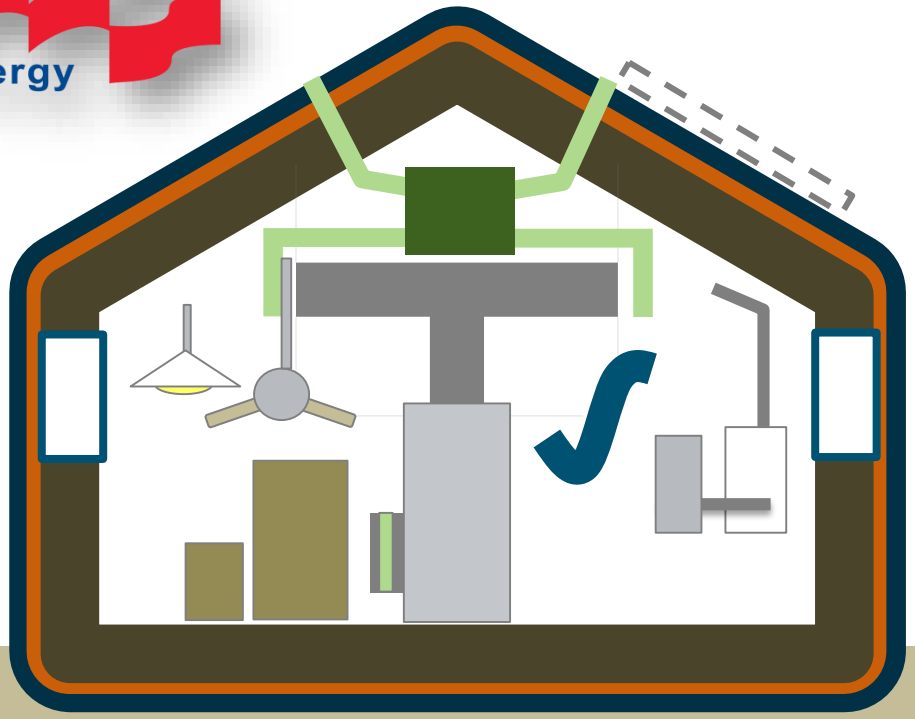
Goal: ~50% Savings

22 Quads Total

U.S. Residential Buildings Primary Energy Consumption

* Source: U.S. EIA

The Prize



High-performance homes, so energy efficient,

all or most annual energy consumption
can be offset by renewable energy.

The Business Case

High-Performance Home Impacts:*

- **~$350 Billion – $1+ Trillion** Utility Bill Savings
- **~$20 - $100+ Billion** Annual Health Related Benefits
- **~$90 – $270 Billion** Annual Construction Revenue
- **~120,000 – 360,000** Persistent New Jobs

* Estimated impacts based on internal DOE analysis assuming 30% penetration of high-performance new and existing homes by 2025

- **$170 homeowner savings per $1 spent**

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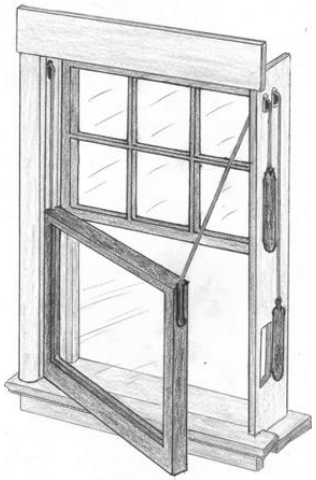
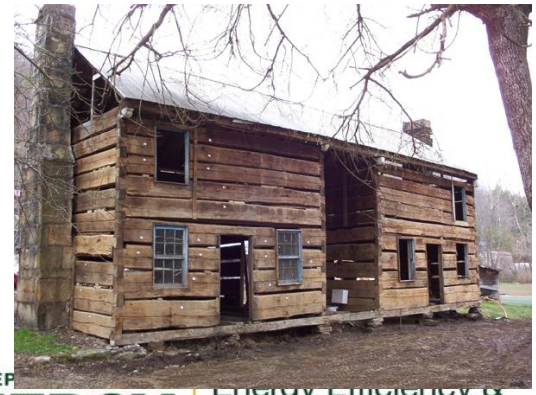
Building Materials Are Changing





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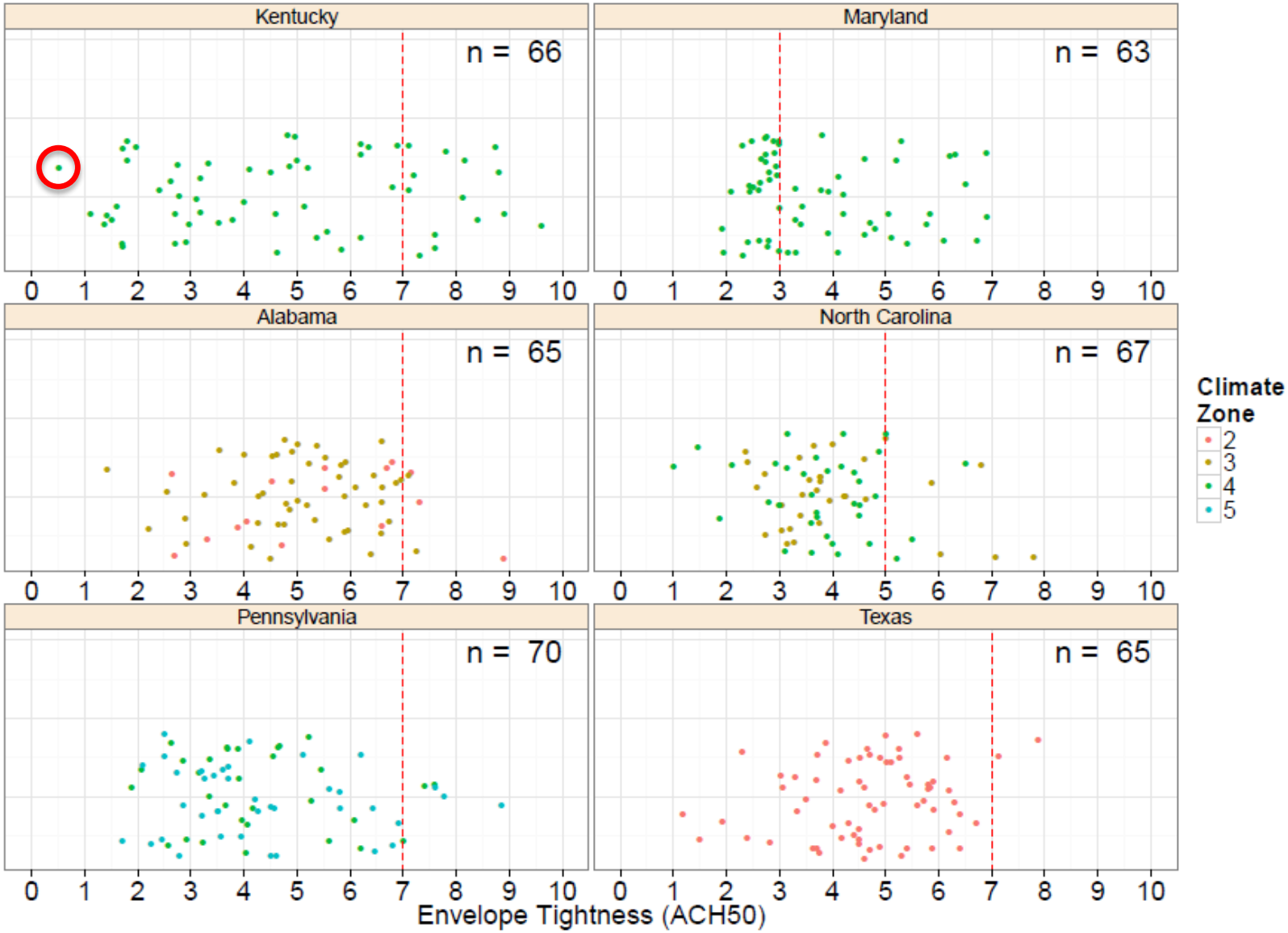
Average New Homes in These States are Tighter

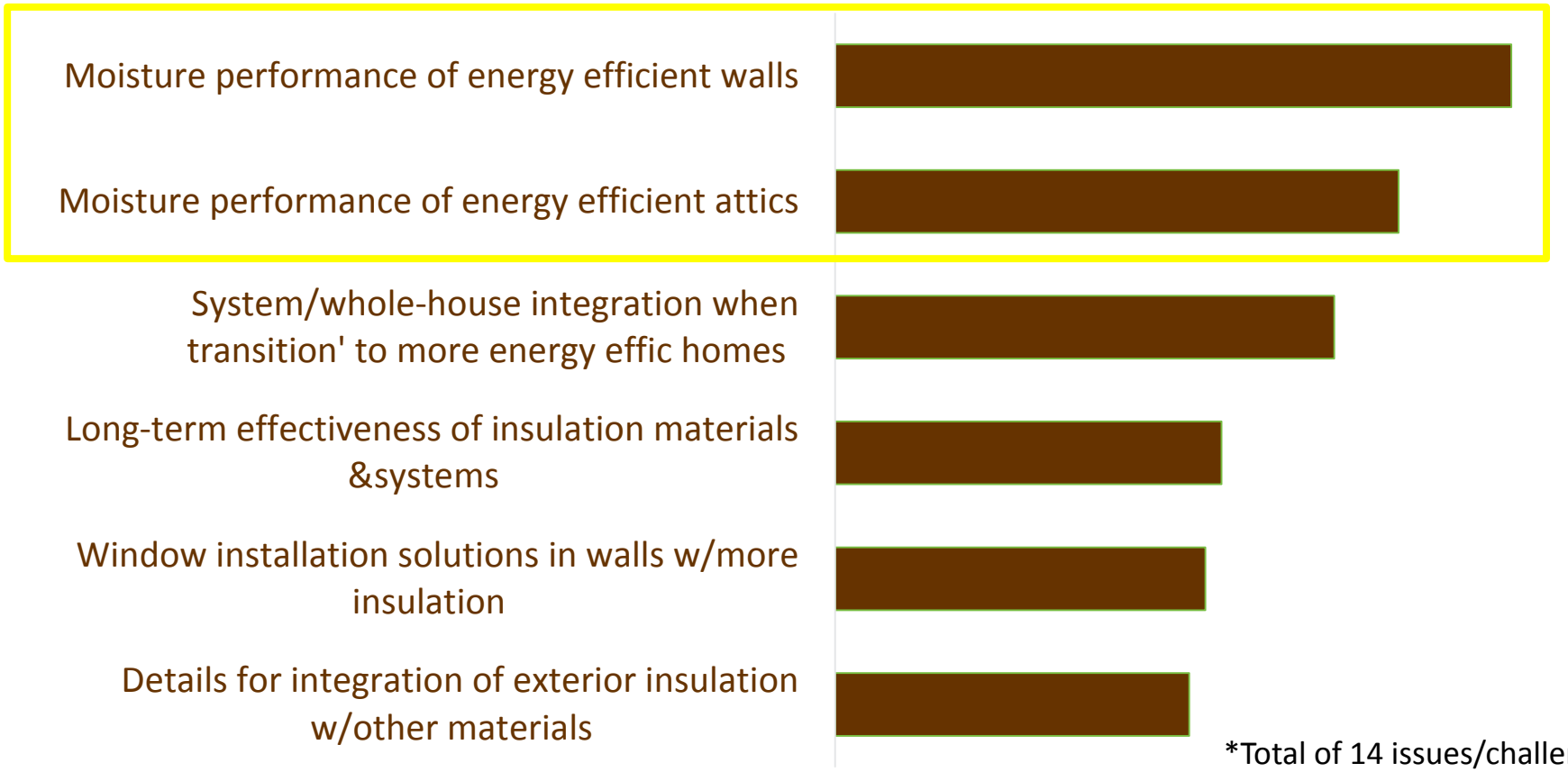


Technology & Expectations are Changing

Anyone who looks can find defects

Building Industry Concerns

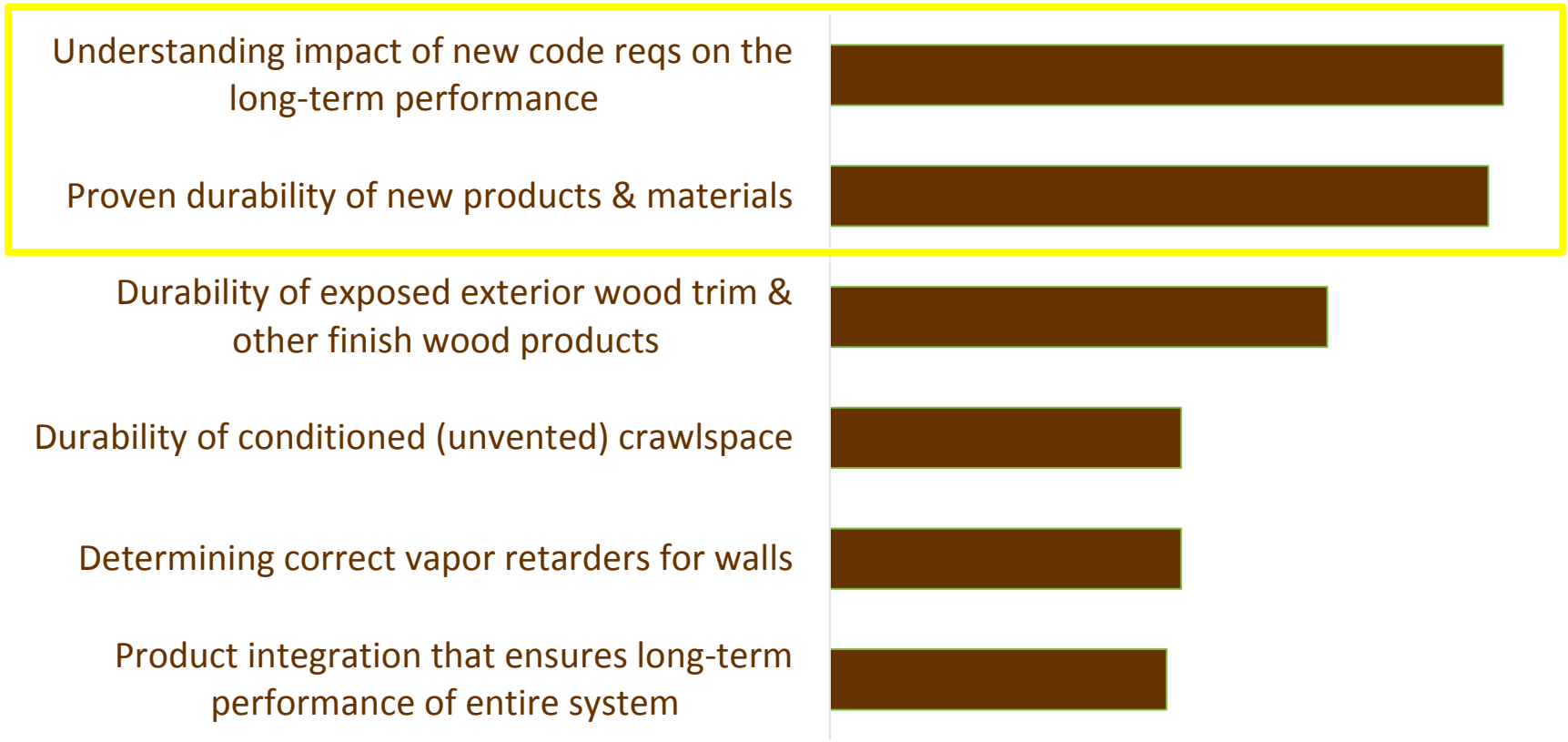
Top Challenges in Energy Efficiency



*Total of 14 issues/challenges presented to respondents

Building Industry Concerns

Top Challenges in Durability



*Total of 19 issues/challenges presented to respondents

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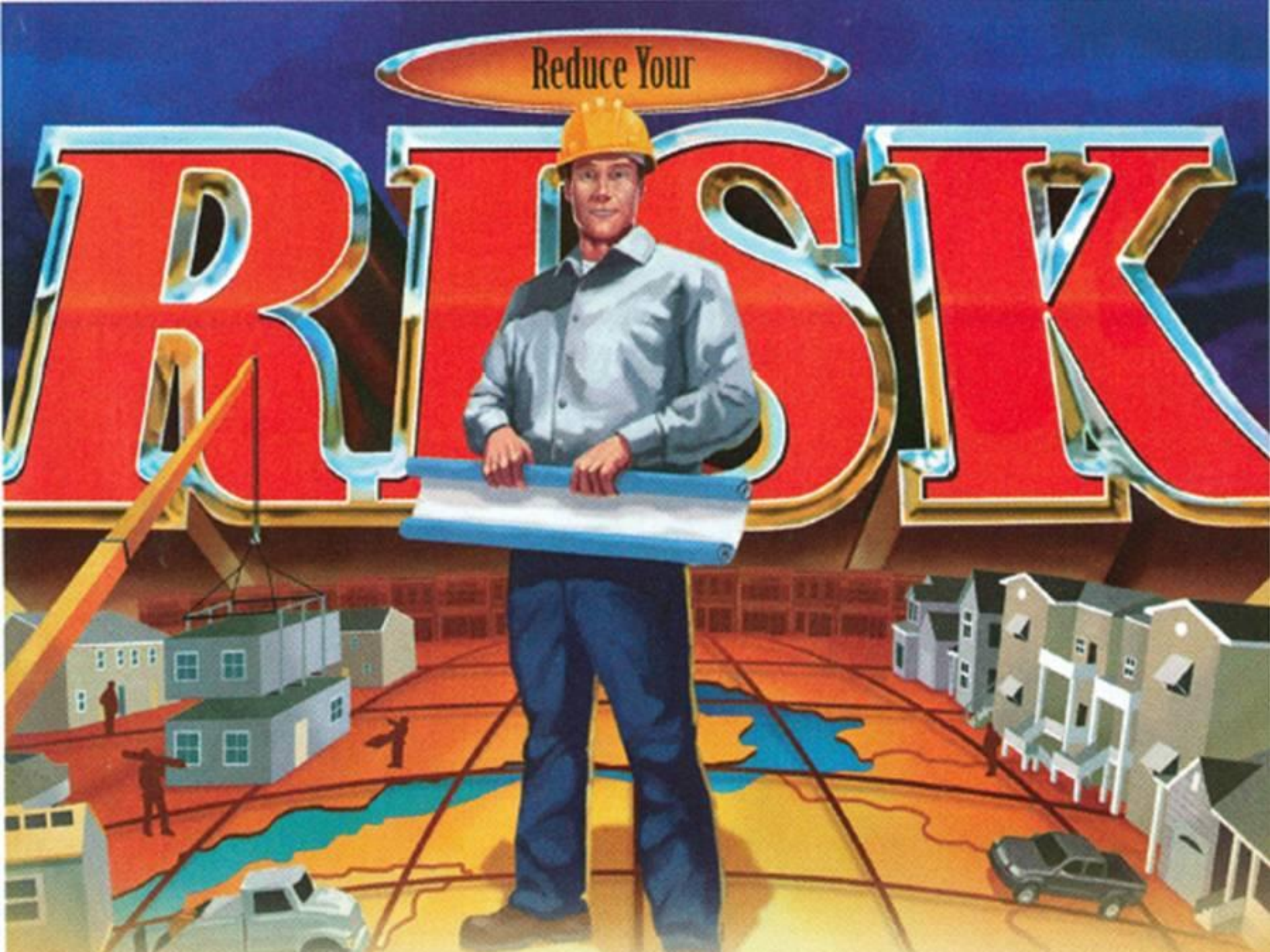

Reduce Your
RISK

Remaining Technical Challenges to High Performance

1. Moisture Durability Risks of Insulated Envelopes

Risk of condensation & inadequate drying potential inside building assemblies

2. Comfort Risks in Low-Load Homes

Risk of inadequate air flow and RH control at part load conditions

3. Indoor Air Quality Risks in Tight Homes

Risk of poor indoor air quality in tight homes

Building America is Tackling These Challenges

for Energy Efficient New and Existing Homes:

1. Moisture Managed High-R Envelopes

- Reduce Heating/Cooling Loads & Improve Durability
  High performance homes with increased insulation, reduced infiltration, reduced risk of condensation, & adequate drying potential inside building assemblies

2. Optimized Low-Load Comfort Solutions

- Effectively Manage Airflow & Indoor RH for Comfort
  High efficiency comfort systems for homes with low thermal loads, including optimal efficiency, managed air flow and RH control at all part load conditions

3. Smarter Indoor Air Quality Solutions

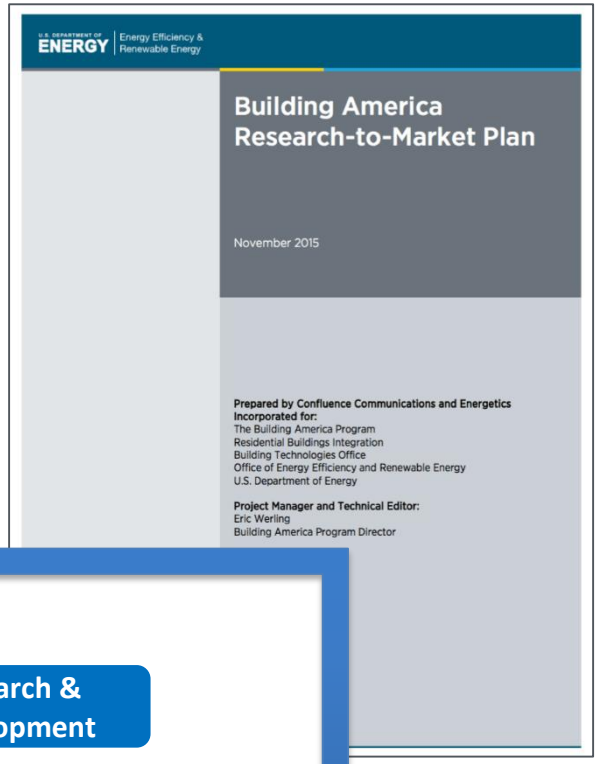
- Control Fresh Air Supply & Contaminant Removal
  Added tightness with improved source control, dilution, and high efficiency filtration, with little or no energy penalty

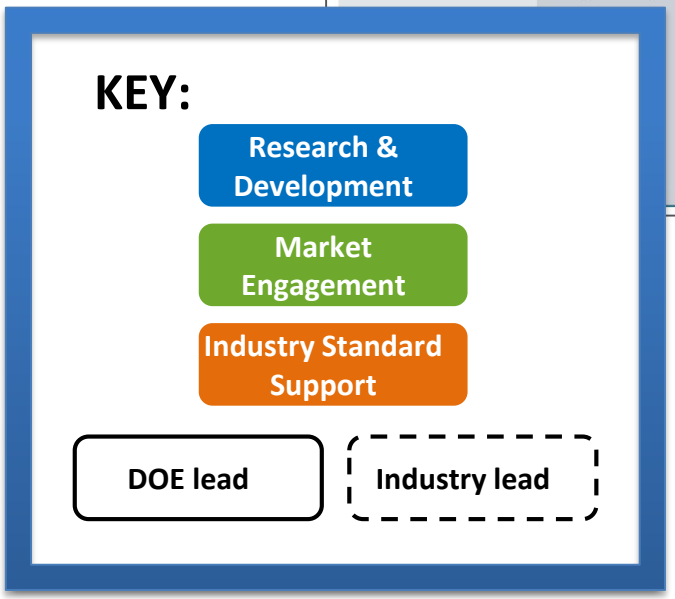
Building America Technology to Market Roadmaps

A. High Performance, Moisture Managed Envelope Systems

B. Optimal HVAC Systems for Low Load Homes

C. Optimal Ventilation and IAQ Solutions for Low Load Homes





Roadmap Objectives:

- Improve Standard Practice
- Manage Risks
- Optimize Performance
- Practical, Profitable Solutions

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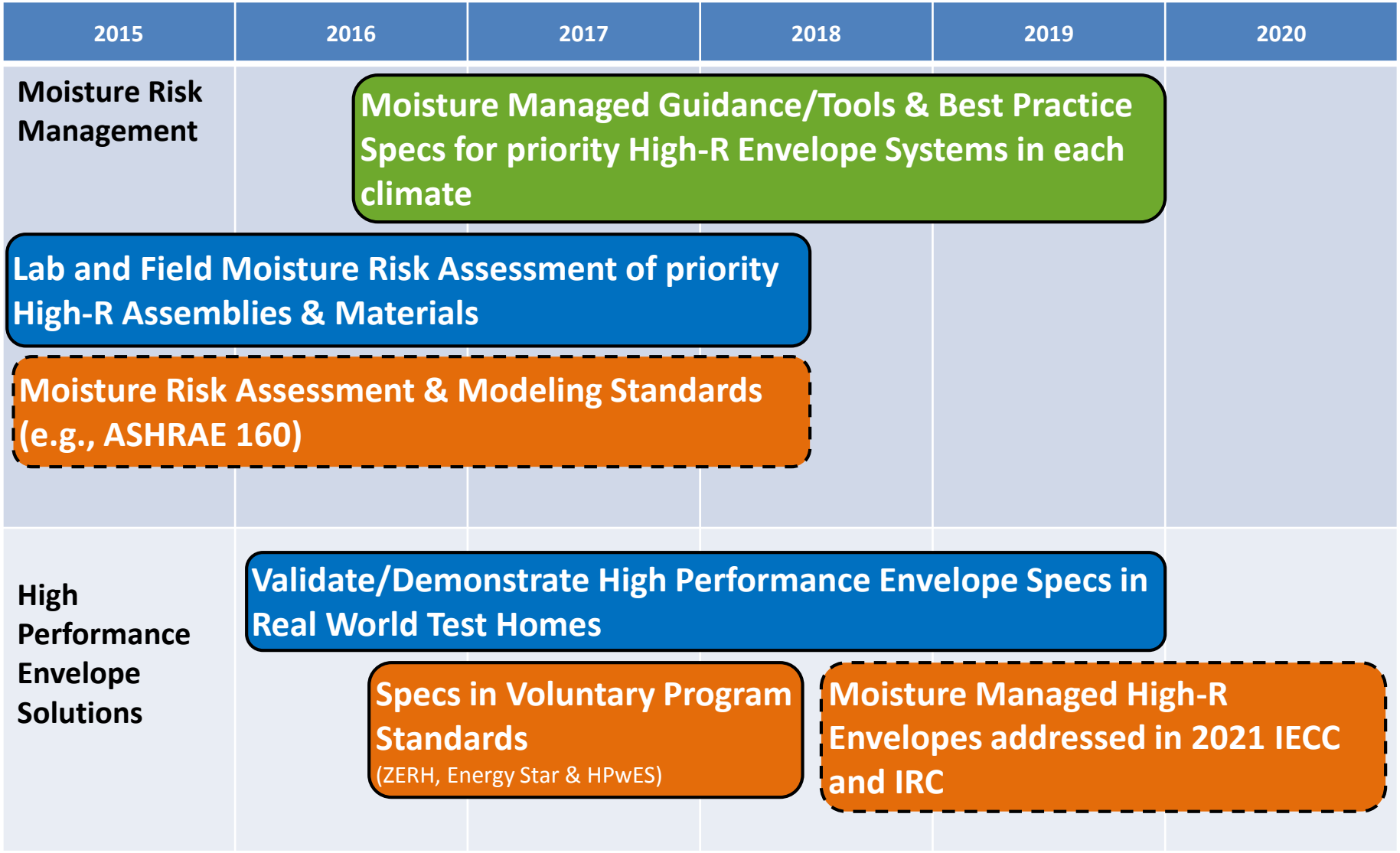
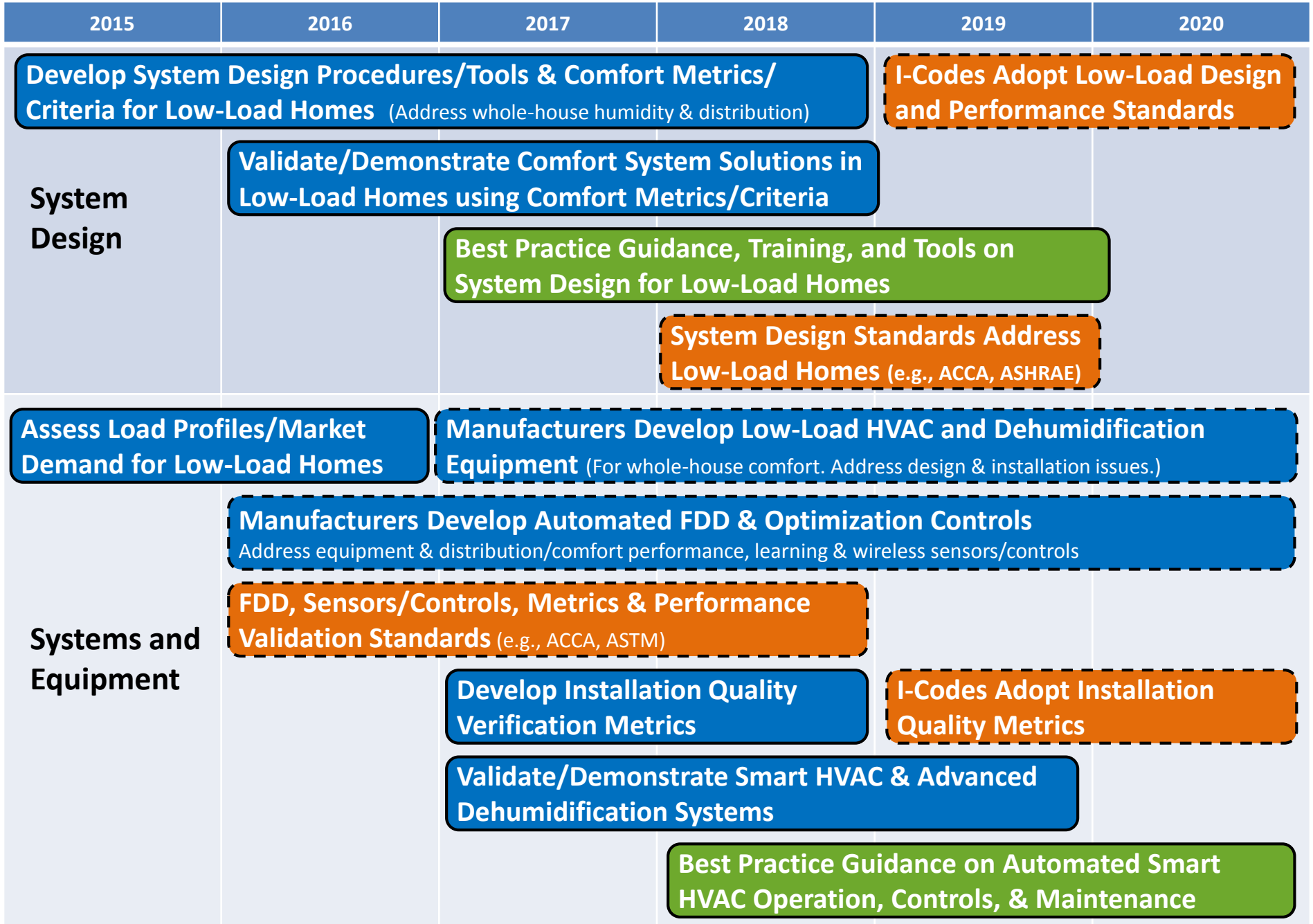
A. High Performance Moisture Managed Envelopes



B. Optimal Comfort Systems for Low-Load Homes



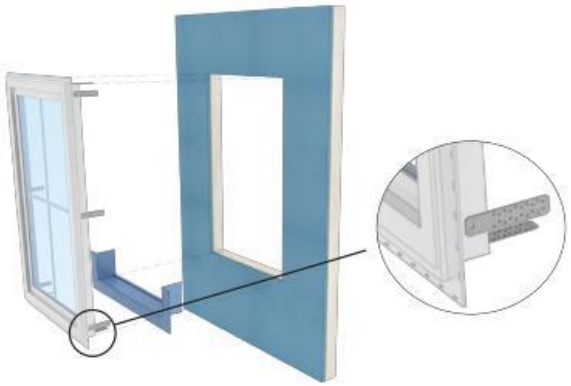
C. Optimal Ventilation & IAQ Solutions

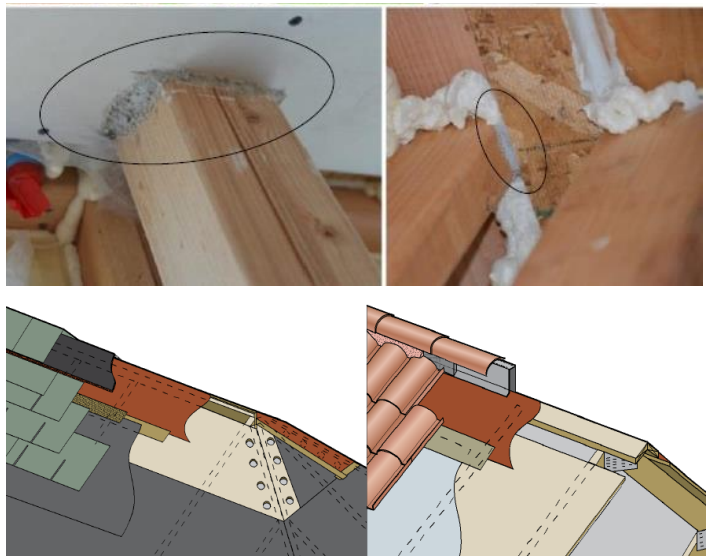
Building America Research Activities in FY17

- Ongoing Research Projects to Address Roadmap Objectives (FY15-16 funded FOAs & FY17 Lab AOPs):
  - Envelope Projects: 5 Partnership Teams & 2 Nat'l Lab projects
  - HVAC Projects: 4 Teams & 1 Nat'l Lab projects
  - IAQ Projects: 3 Teams and 3 Nat'l Lab projects
- Select/Negotiate/Award FY17 FOA Awards (FOA# DE-FOA-0001630)
  - Topic 1: Additional Projects to Address Remaining Roadmap Objectives
  - Topic 2: Baseline Indoor Air Quality Study of New Occupied Homes

Current Industry Partnership Team Projects (FY15-16 funded):
HIGH PERFORMANCE MOISTURE MANAGED ENVELOPE SOLUTIONS

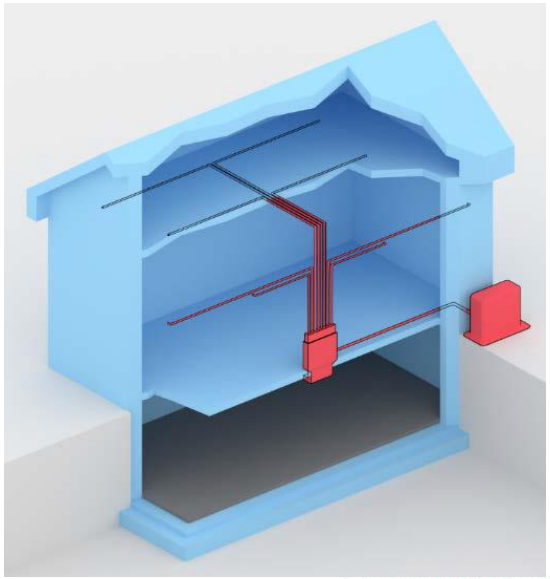
PROJECT LEAD	PROJECT TITLE
Home Innovation Research Labs, Inc.	A Constructible and Durable High-Performance Walls System: Extended Plate and Beam
University of Minnesota - Twin Cities	Achieving Affordable Zero Energy Ready Homes with an Advanced Solid Panel Wall System
Center for Energy and Environment	Aerosol Sealing in New Construction
Home Innovation Research Labs, Inc.	Attic Retrofits Using Nail-Based Insulated Panels
Home Innovation Research Labs, Inc.	Moisture Performance of High-R Wall Systems
Building Science Corporation	Monitoring of Unvented Roofs with Diffusion Vents and Interior Vapor Control in a Cold Climate
Home Innovation Research Labs, Inc.	Structural Support of Windows in Walls with Continuous Insulation





Current Industry Partnership Team Projects (FY15-16 funded):
OPTIMAL COMFORT SYSTEMS FOR LOW LOAD HOMES

PROJECT LEAD	PROJECT TITLE
IBACOS (Integrated Building and Construction Solutions)	A "Plug-n-Play" Air Delivery System for Low-Load Homes and Evaluation of a Residential Thermal Comfort Rating Method
University of Central Florida	Building America Partnership for Improved Residential Construction (Lab and Field Testing of High Efficiency HVAC Systems for Low-Load Homes)
The Levy Partnership, Inc.	Integrated Design: A High Performance Solution for Affordable Housing
Fraunhofer USA, Inc.	Physics-based Interval Data Models to Automate and Scale Home Energy Performance Evaluations
Steven Winter Associates, Inc.	Ventilation Integrated Comfort System



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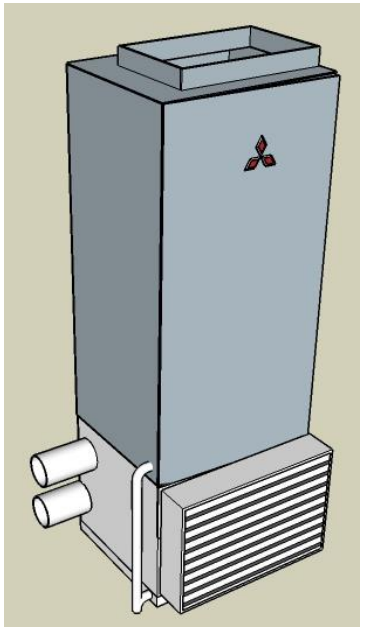
Current Industry Partnership Team Projects (FY15-16 funded):
OPTIMAL VENTILATION & INDOOR AIR QUALITY (IAQ) SOLUTIONS

PROJECT LEAD	PROJECT TITLE
University of Central Florida	Building America Partnership for Improved Residential Construction (Temperature and Humidity Controlled Smart Ventilation)
Newport Partners	Development of the Industry's First Smart Range Hood
Gas Technology Institute	Energy Savings with Acceptable Indoor Air Quality Through Improved Air Flow Control
Southface Energy Institute	Performance-Based Indoor Air Quality and Optimized Ventilation
Steven Winter Associates, Inc.	Ventilation Integrated Comfort System



Building America National Laboratory Activities in FY17

- **Whole house energy analysis tools & standards (NREL)**:
  - Develop EnergyPlus/Open Studio interface and state-of-the-art energy analysis capabilities for residential buildings (public domain)
  - Nat'l Lab support to RESNET Std committee on HERS software accuracy
- **Building envelope knowledge, tools, & roadmap support (ORNL)**:
  - Launch *Building Science Advisor v1*, a decision support tool for builders to understand & manage moisture risks of wall designs
  - DOE & Nat'l Lab support to ASHRAE Std committee on envelope moisture analysis
- **HVAC market research, analysis, & roadmap support (multiple Labs):**
  - HVAC market characterization for energy efficient homes
  - Industry stakeholder engagement on HVAC QI (ACCA, ASHRAE, etc.)
- **IAQ knowledge, tools, & roadmap support (LBNL):**
  - Develop & vet draft Home IAQ score (like HERS)
  - DOE & Nat'l Lab support to ASHRAE Std committee on residential ventilation & IAQ
- **Building America Solution Center (PNNL):**
  - Complete existing home guidance taxonomy
  - Develop new guidance from R&D results

Building America Technology to Market

World Class Guidance for High-Performance Homes…

… at Your Finger Tips

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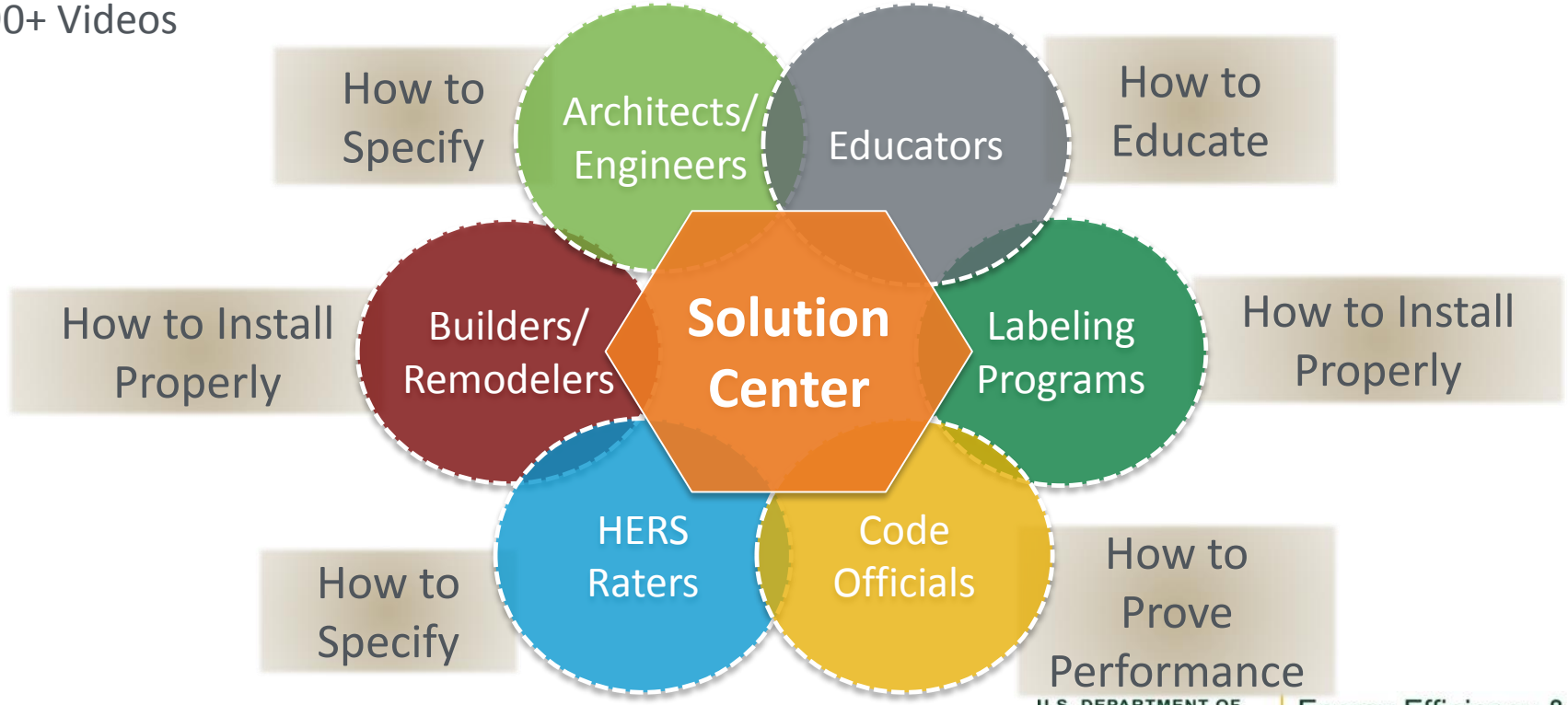
Building America Solution Center Snapshot

- 200+ best practice guides
- 1,500+ images
- 115+ CAD drawings
- 270+ proven performance case studies
- 530+ peer-reviewed references & resources
- 25+ Code Compliance Briefs
- 90+ Videos



Building America Solution Center

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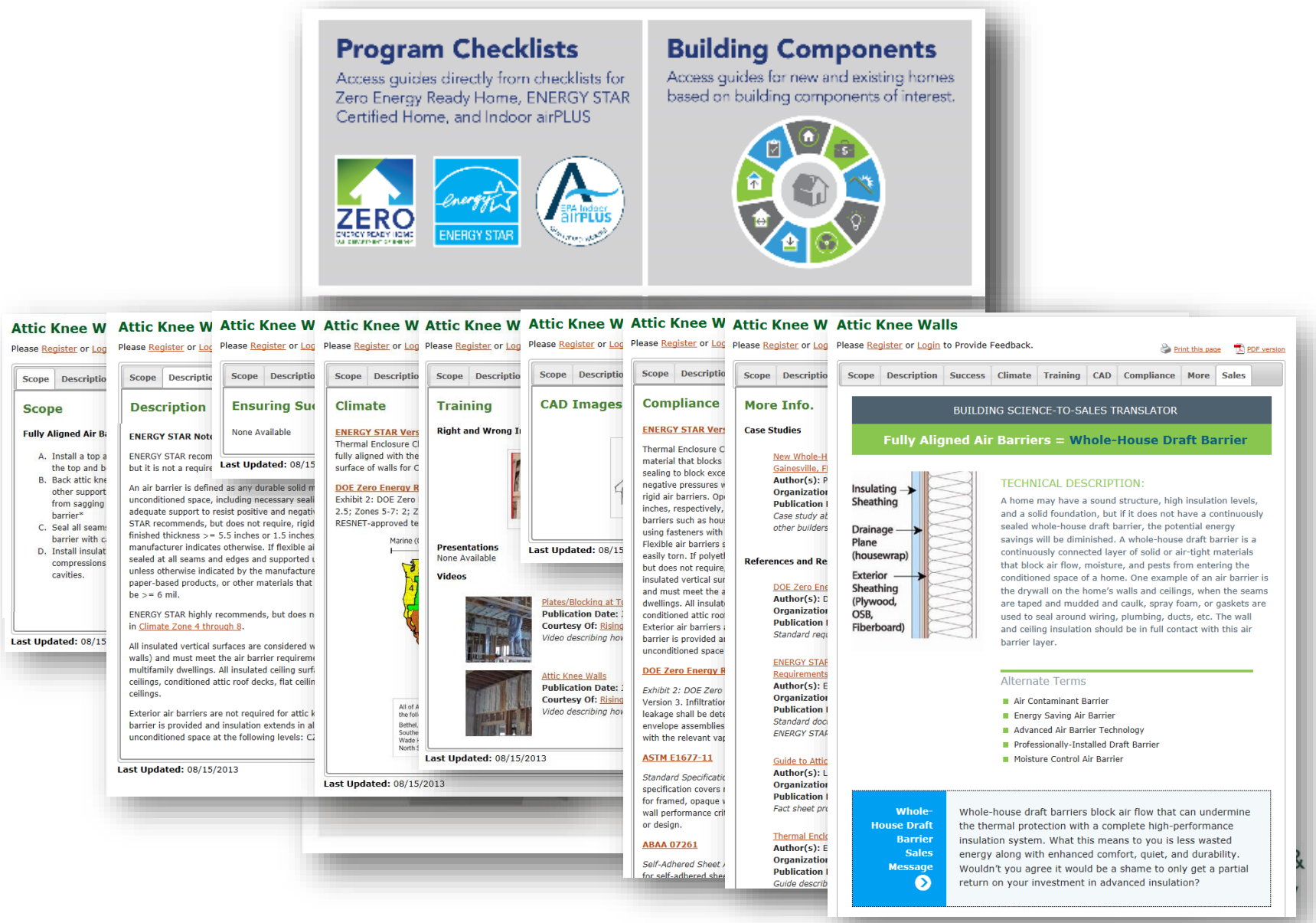
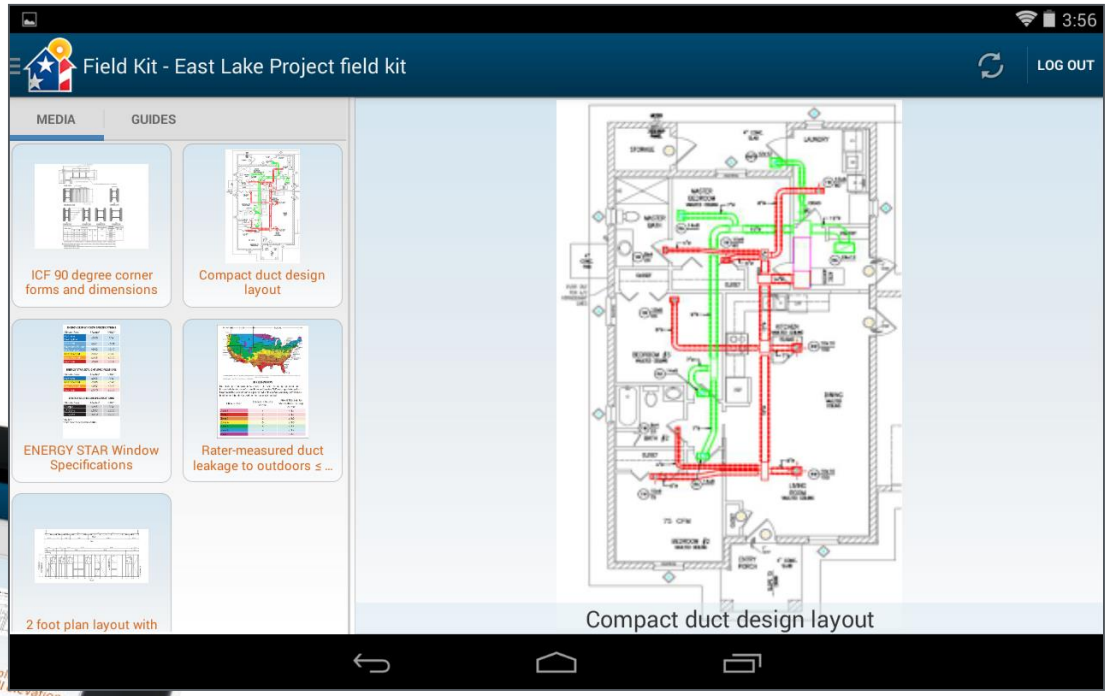
Building America Solution Center

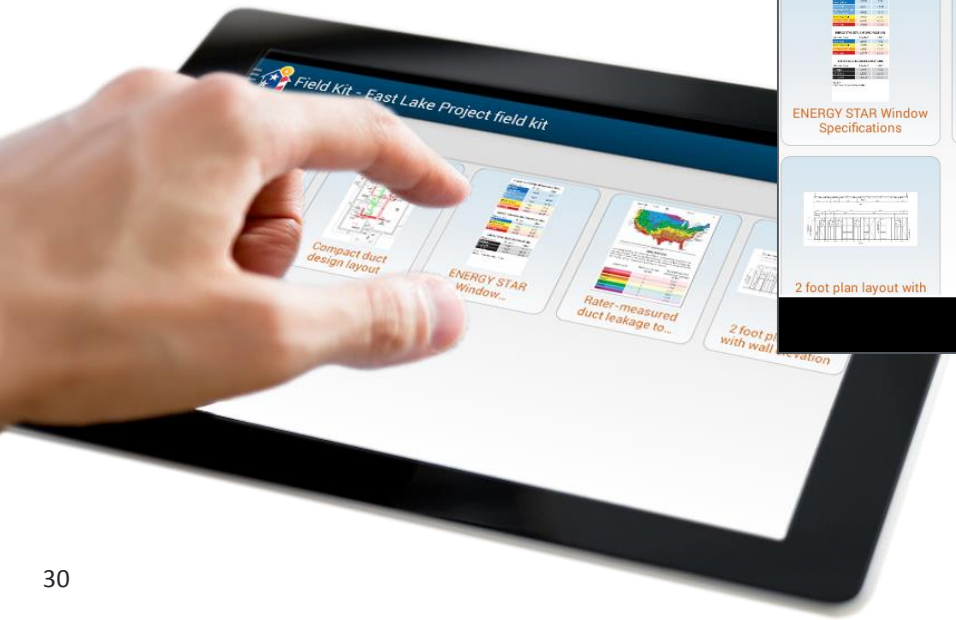


BASC Mobile Access

Access your Building America Field Kits remotely using the new “Solutions” mobile application for Android and iOS. Access the iOS app through the Apple store, and use the link below for the Android app.

- Access media
- Access guides
- Access Field Kits for specific construction projects





https://basc.energy.gov/solutions

Field kits can also be accessed from computers

Measuring Progress

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One measure of success: BTO Goals

Climate	EUI 2010 Baseline (kBtu/ft²/yr)	New Home 60% Reduction EUI Target (kBtu/ft²/yr)	Number of Case Studies Achieving Target or Better
Very Cold/Cold	112.9	45.1	4
Hot-Dry/Mixed-Dry	115.4	46.2	1
Hot-Humid	124.9	50	2
Mixed-Humid	117.4	47.0	1
Marine	111.8	44.7	0

Climate	EUI 2010 Baseline (kBtu/ft²/yr)	Existing Home 40% Reduction EUI Target (kBtu/ft²/yr)	Number of Case Studies Achieving Target or Better
Very Cold/Cold	112.9	67.7	9
Hot-Dry/Mixed-Dry	115.4	69.3	0
Hot-Humid	124.9	74.9	1
Mixed-Humid	117.4	70.4	0
Marine	111.8	67.1	2

Another measure of success: Industry Engagement

12,812 Subscribers

Building America Subscribers

UP 227% since 2012

501,198 Pageviews

Website Pageviews **UP 43%** in 2016

Another measure of success …

The Building America Program is filling an essential role in the marketplace*—one that would be extremely difficult for the private sector to perform. I believe that investments by the federal government in this program reap huge rewards at the local level in terms of energy savings, comfort, and consumer protection.*

*—**Ron Flax**, Sustainability Examiner for Boulder County Land Use (Colorado)*

*"Pulte has been working with the Building America Program since it began. **Building America has helped our business** research and develop strong new high-performance products that keep us competitive and offer our homebuyers exceptional efficiency and quality."*

*—**Robert Broad**, PulteGroup Southern California/Southern Nevada Division*

*"We used the U.S. Department of Energy's Building America program and its work with the energy efficiency industry to **bring state-of-the-art construction innovations and resources to the public**."*

*—**Carolyn G. Goodman**, Mayor of Las Vegas, Nevada*

*"**Building America provides a much needed resource to our business and the industry**. As a new home builder, we rely on the program to develop and demonstrate innovative technologies before we take the risk of putting them into our construction practices. Without Building America, the construction industry would have great difficulty adopting new practices."*

*—**Tom Wade**, Palo Duro Homes*

Questions?

Thank You

Email me (I ran out of business cards):

eric.werling@ee.doe.gov

Relationships with other Departments

- Building America Solution Center designed to provide technical guidance to **EPA Energy Star Homes & Indoor airPLUS program partners** based on Building America R&D
- Building America collaborates with **EPA, HUD, & NIST** on related R&D objectives, including shared stakeholder engagement, FOA merit reviewer participation, and inter-agency research planning
- **DOE Building America Program, HUD Healthy Homes Office, and EPA Indoor Environments Division** have a current inter-agency agreement on Healthy Efficient Homes, co-funding a collaborative R&D agenda
- Building America partnership team (Building Science Corporation) provided primary design services for the **NIST** Zero Energy Home Test Facility.
- Building America Teams and Nat'l Labs provide technical support/guidance on building science to numerous programs and agencies, including **DOE WAP, FEMP, EPA, HUD, FEMA, & DOD**