Building America Overview

April 22, 2014

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

The Hub of Innovation for American Housing

Eric Werling
Program Coordinator
Building America

DOE Residential Buildings Integration (RBI) Program Overview

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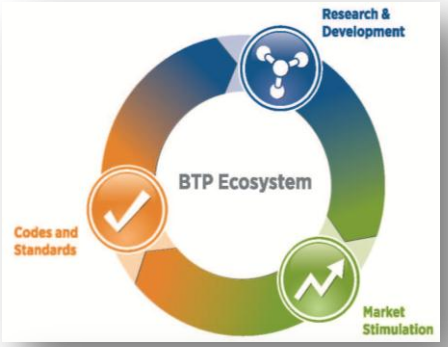
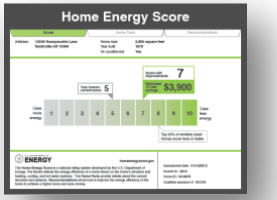
- RBI Program integral part of BTO Ecosystem
- Prior to 2008, primary RBI focus was applied research through Building America
- Since 2009, deployment programs have built upon Building America
  - DOE Challenge Home
  - Home Energy Score
  - Better Buildings Neighborhood Grant Program
  - Better Buildings Residential Program
  - Home Performance with ENERGY STAR



Building AMERICA
U.S. Department of Energy

Better Buildings
NEIGHBORHOOD PROGRAM
U.S. DEPARTMENT OF ENERGY

U.S. DEPARTMENT OF ENERGY
CHALLENGE HOME



HOME PERFORMANCE WITH ENERGY STAR

RBI Programs and External Impacts

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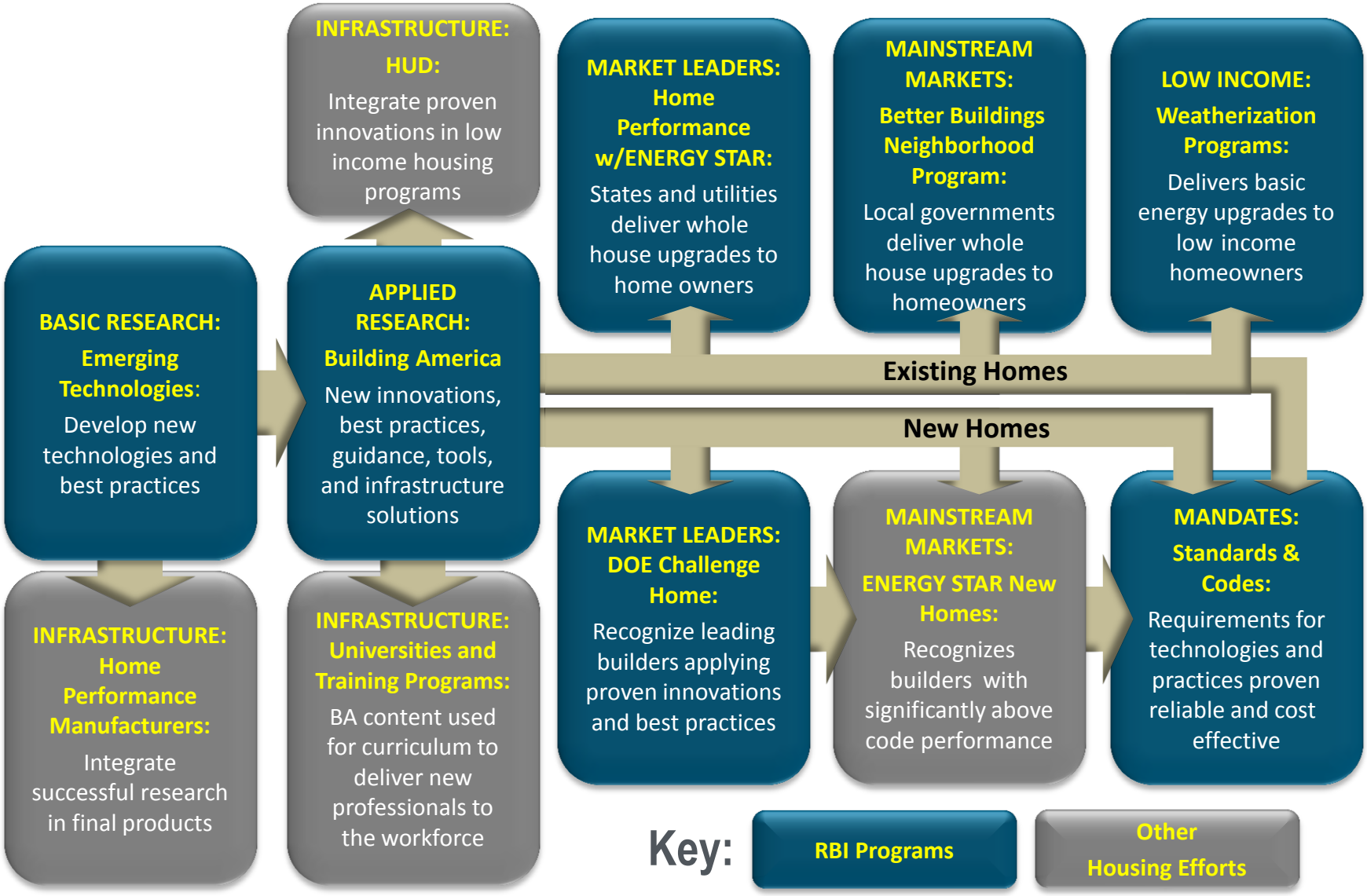


Building America
Program Overview

- Business Case
- Goals
- Strategy
- Project Portfolio
- Intro to Teams

Home Energy Economic Impact

22%: Household's Share of U.S. Energy Use

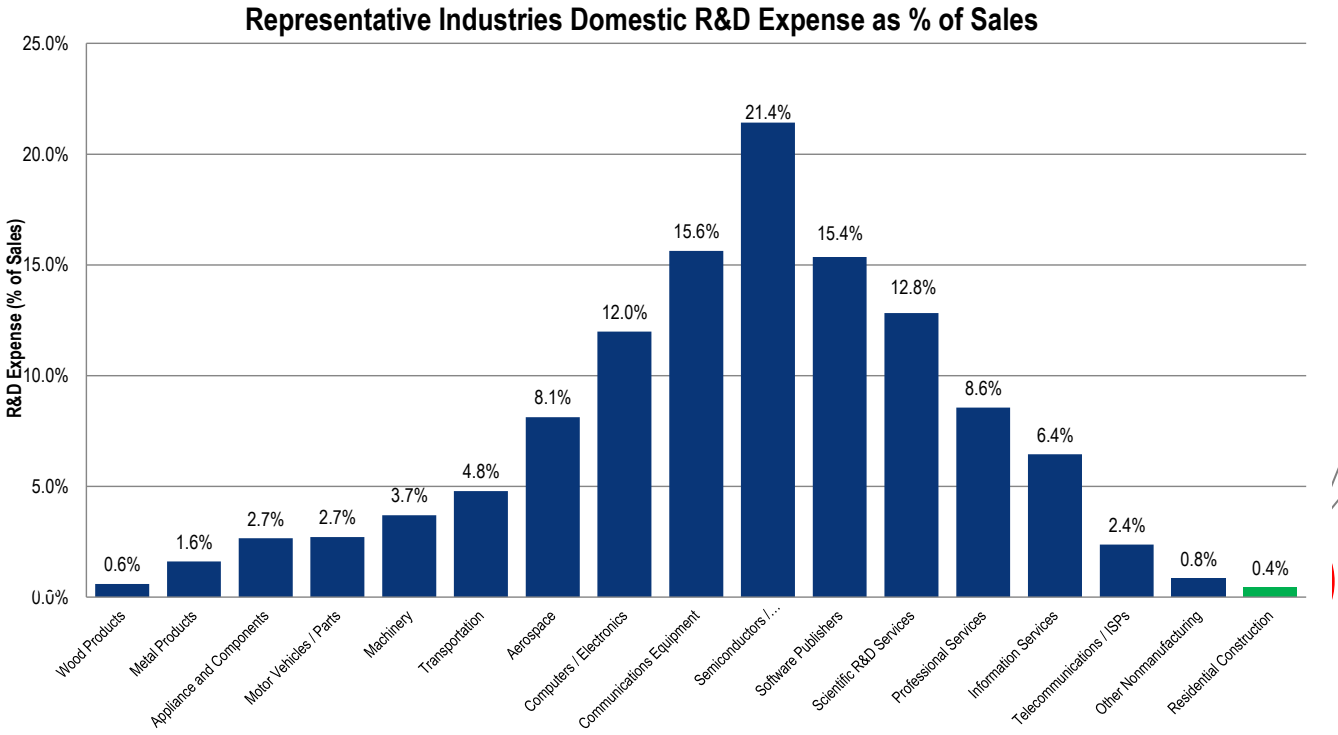
$2,200: Avg. Annual Household Energy Bill

>113,000,000: Housing Units in America

$250 Billion: Amount spent on home utility bills per year in U.S. Households.

$125 Billion: Available to the economy each year if we make our houses 50% more efficient.

Housing Under-Invests in R&D



Need for Building America

- The residential sector consumes 22% of U.S. energy
- Yet, it spends less than 0.4% on research
- The housing market is highly fragmented with close to 500,000 contractors and builders; typical industry has less than 10,000 actors

Building America Fills Market Need for a

High-Performance Homes

HUB of Innovation

Building America
U.S. Department of Energy

Building America Goal

Goal: Market adoption by 2030 of integrated cost effective technologies, that achieve up to 50% energy savings in new and existing homes, while improving health, comfort and durability.

Strategy: Research, demonstration and market transformation strategies, in partnership with industry, that accelerate innovation in housing.

Approach: Residential Systems RD&D + Early Market Transformation

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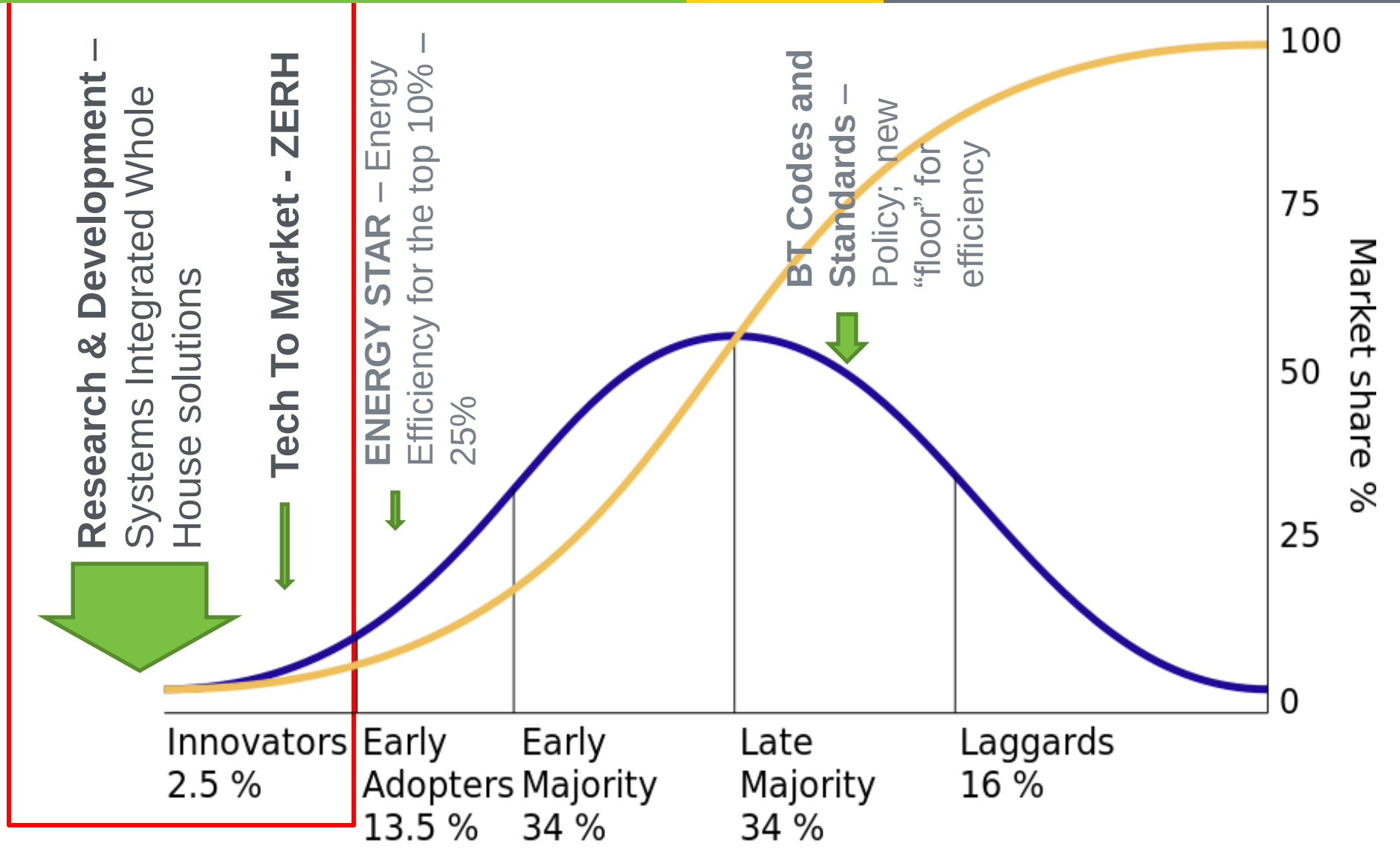
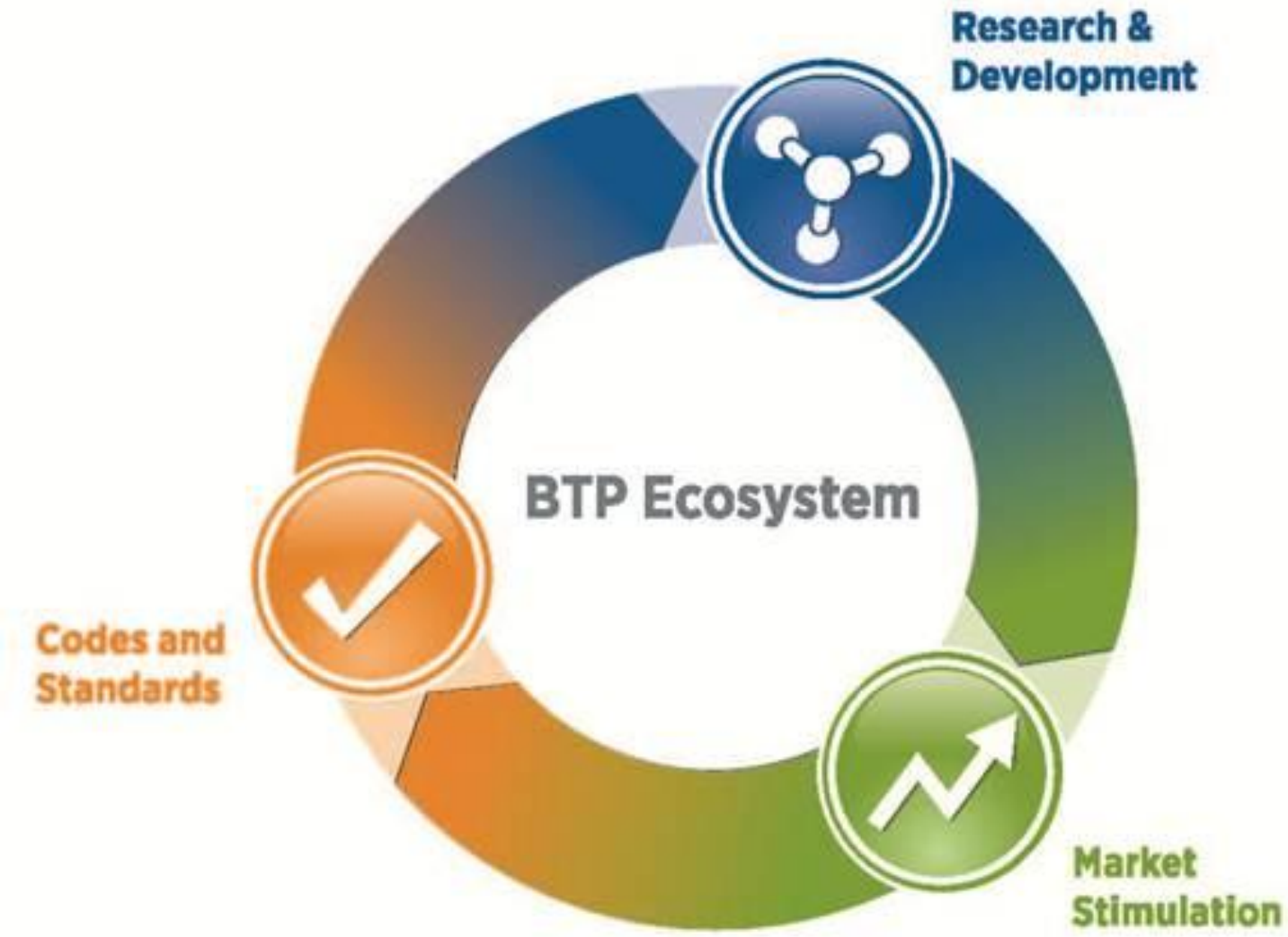
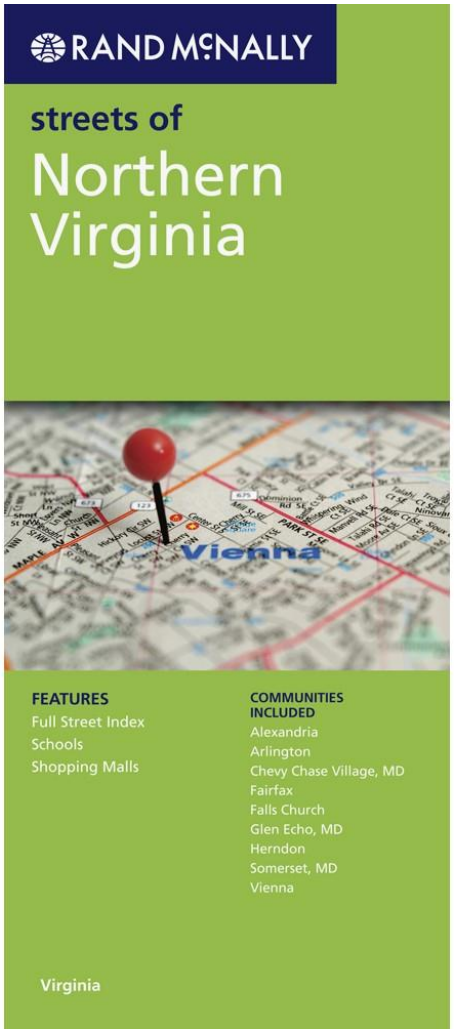


Building America Works with the Whole BTO Ecosystem



We Need a Roadmap? Really?



Remember these?

I prefer my GPS…

Meet Nancy Navigator

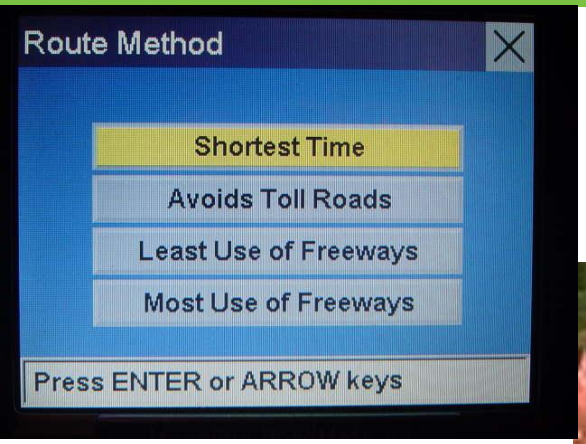
Four easy steps to reach your destination…

1. Type in Destination

ZERO ENERGY READY HOME
U.S. DEPARTMENT OF ENERGY

The Most Efficient, Sustainable Homes are…

2. Choose Preferred Route



Shortest Time, Avoid Tolls…

Apply Integrated Systems to Achieve:

Ultra-High Efficiency

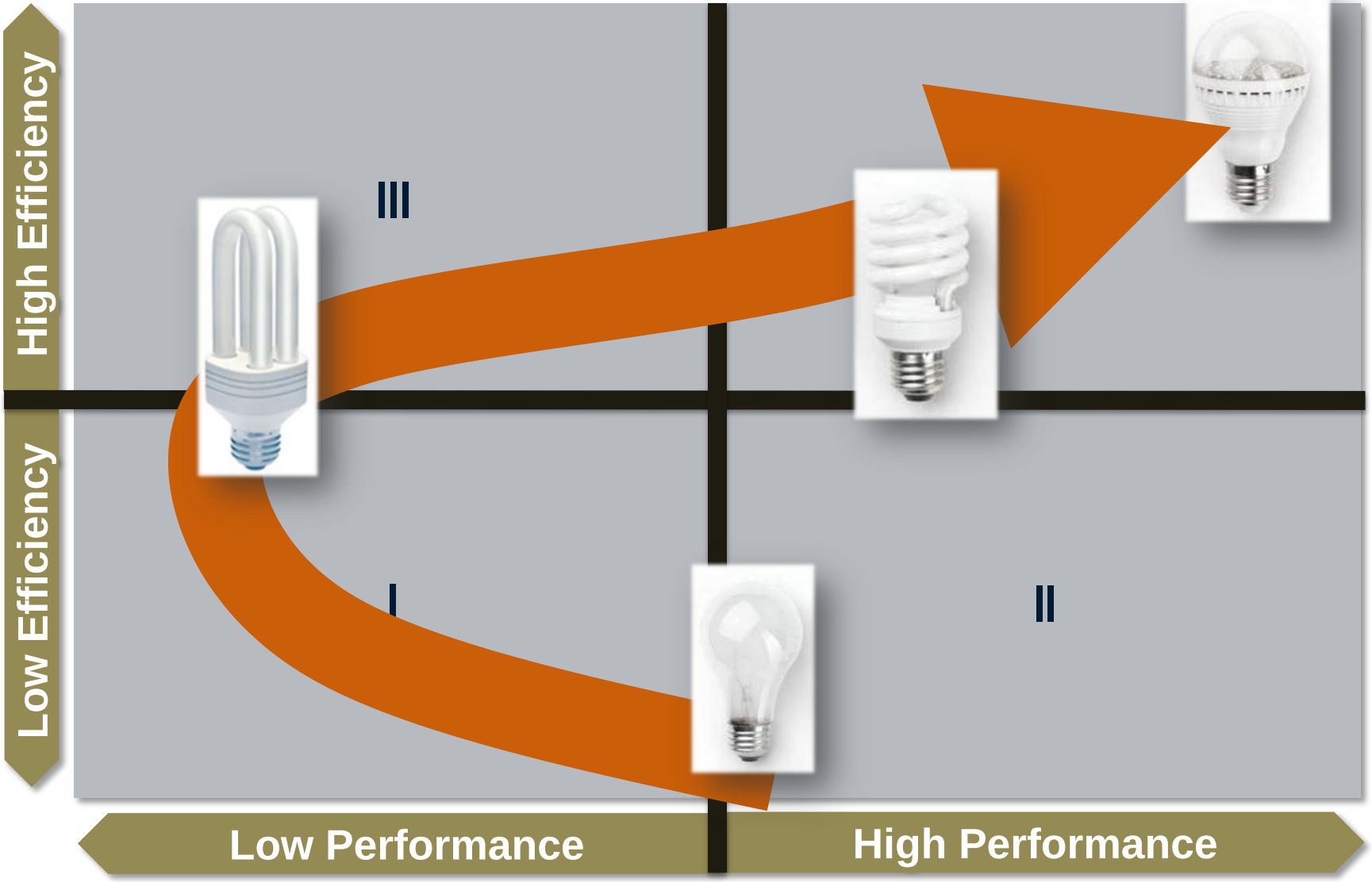
- Enclosure
- Low-Load HVAC
- Components

+

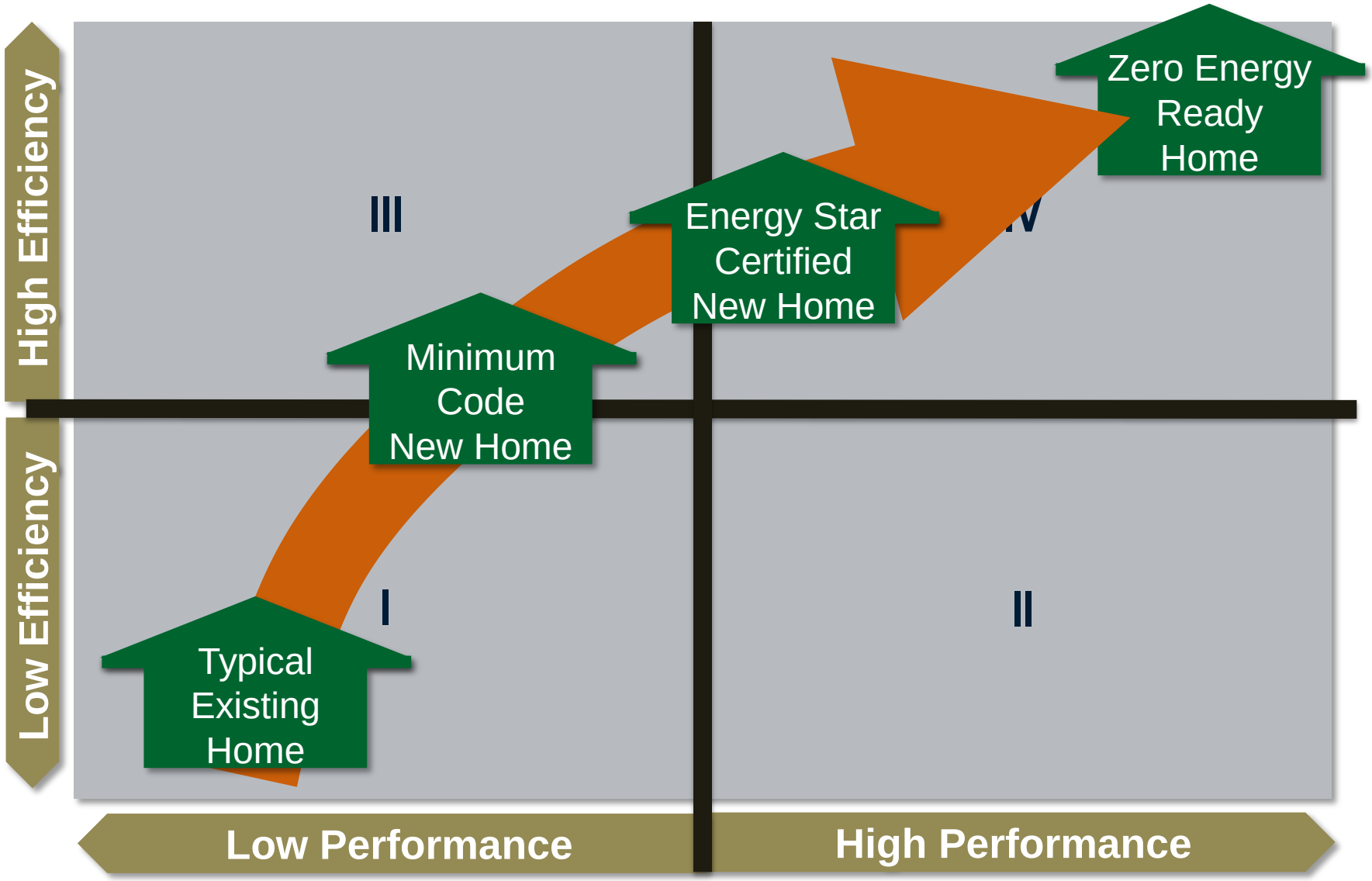
Assured Performance

- Affordable
- Comfort
- Health
- Durability
- Renewable Readiness
- Water Conservation
- Disaster Resistance

Why Efficiency + Performance



Why Efficiency + Performance



Building America Technology Roadmap

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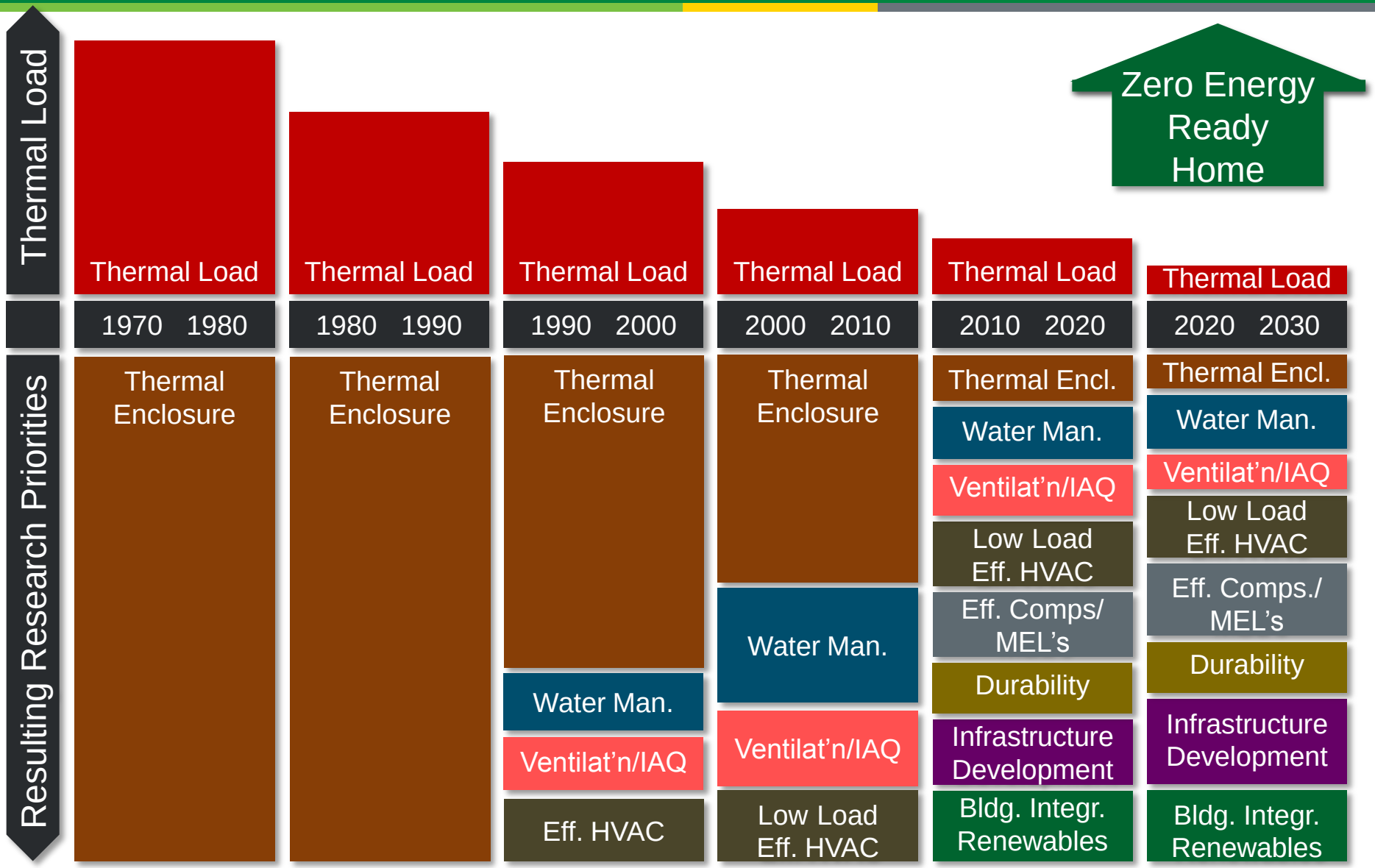


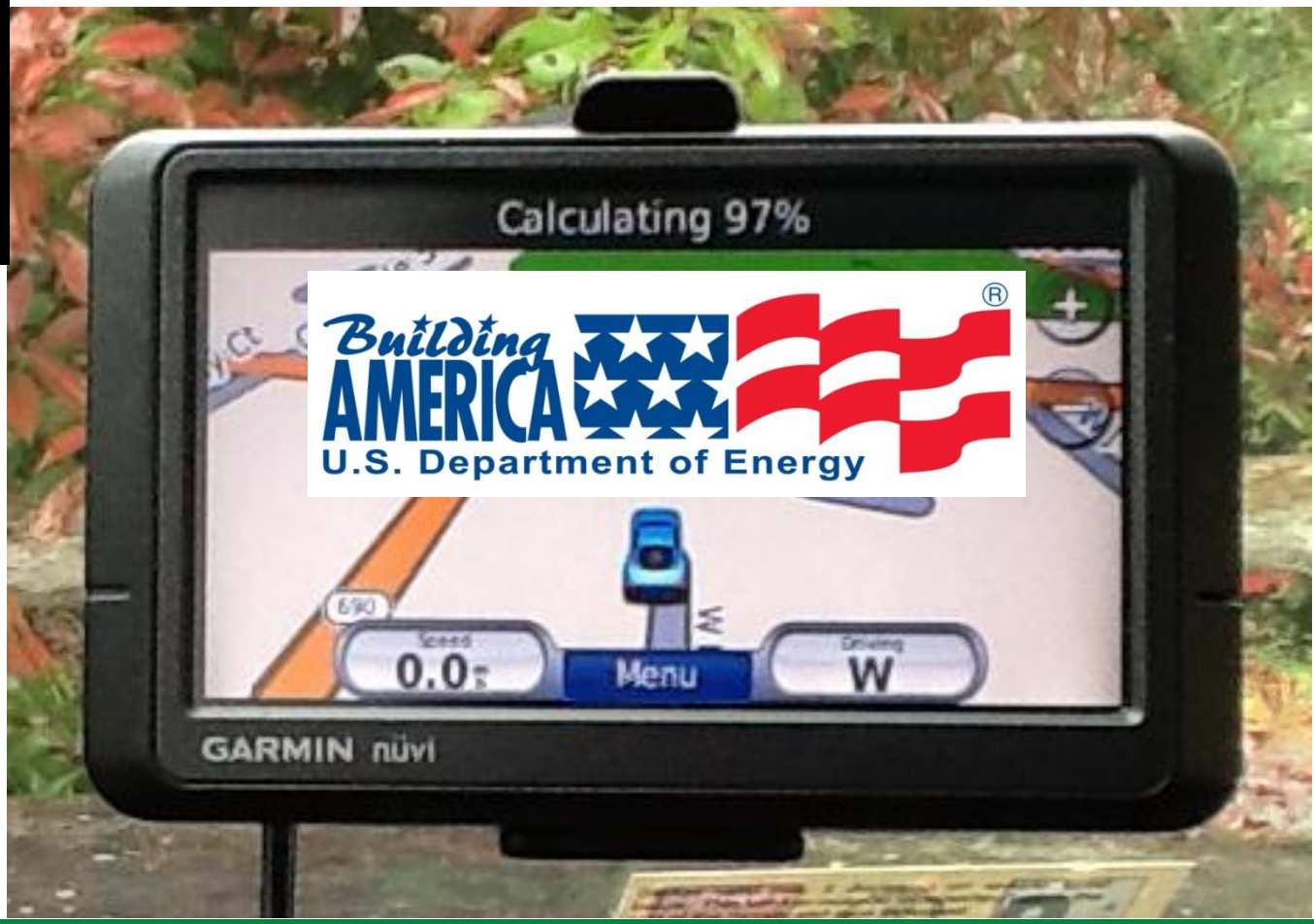
Execute the Strategy

Building America Strategic Initiatives

- Building America R&D Project Portfolio
- Building America Solution Center
- Building America Top Innovations
- DOE Zero Energy Ready Homes
- Strategic Initiatives to Fill Deployment Gaps:
  - Building Science Education (e.g., Student Design Competition)
  - EE Value in Transaction Processes
  - Codes and Standards Innovation

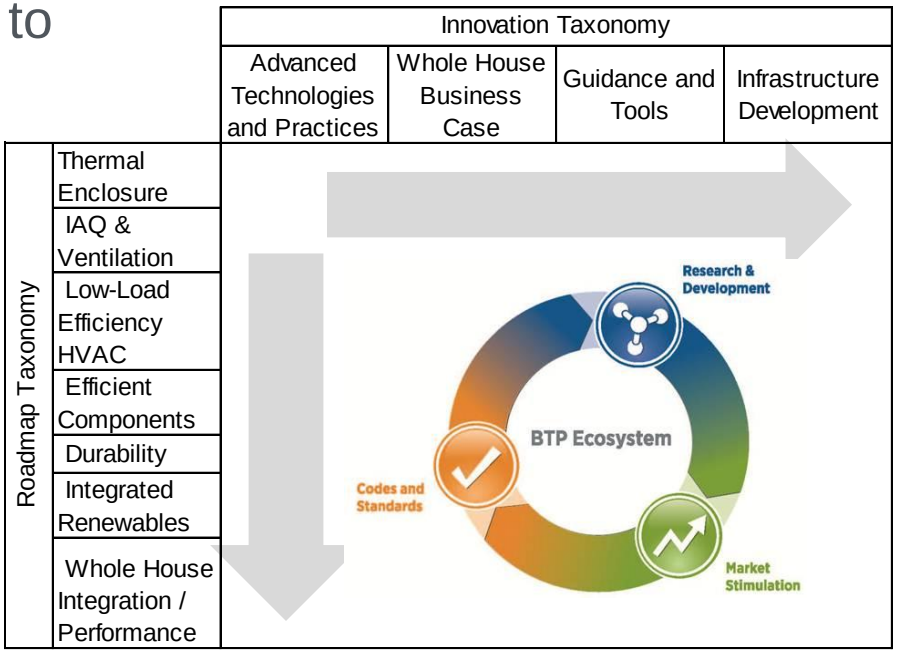
4. Re-route if Necessary

"Recalculating…"



Strategic Portfolio Analysis

- In 2013, strategic portfolio analysis conducted using a two-dimensional strategy (see matrix), addressing gaps in:
  - Technology needs identified in the roadmap (vertical)
  - Deployment needs / technology to market (horizontal)
- Lab & team core strengths & competencies were considered.
- Adjustments in 2014:
  - More balanced portfolio
  - Increased focus on integration & whole house performance.
  - Raising minimum standards
  - More infrastructure gaps addressed (e.g., educating professionals)



Building America is Good Government

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- **Value Added:** Building America teams consistently lead industry to develop and demonstrate housing innovations that would not otherwise be adopted, due to perceived risks and industry momentum

- **Enduring Benefits:** DOE has documented 42 innovations from Building America that are transforming U.S. housing to high performance & energy efficiency

BUILDING AMERICA TOP INNOVATIONS

Recognizing Top Innovations in Building Science

- **High Impact:** Building America Innovations to date estimated at 0.8 Quads – 5% per year of all homes built since 1995 – approximately $8 Billion in utility cost savings

- **Effective Government:** Building America innovations delivered an estimated >$40 utility cost savings for every $1 invested by DOE

Building America Teams & Project Portfolio

Building America U.S. Department of Energy SM Industry Research Teams

Including technical support from NREL, ORNL, LBNL, and PNNL

BA-PIRC

BARA
BUILDING AMERICA RETROFIT ALLIANCE

ARIES
Collaborative

CARB
Consortium for Advanced Residential Buildings

Alliance for Residential Building Innovation

NorthernSTAR

bsc Building Science Corporation

IBACOS
| Home Quality + Performance |

NAHB RESEARCH CENTER SM

PARR
The Partnership for Advanced Residential Retrofit

Building America Research Portfolio Selection

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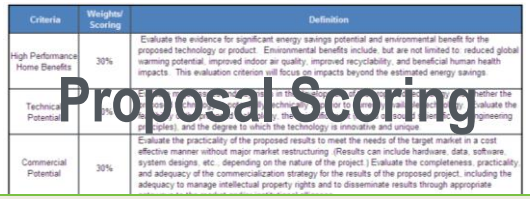
Selection



Proposal Scoring

Decision Criteria (WF's):

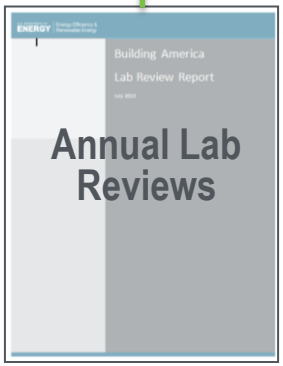
1. Innovation Gaps (Impact & Market Need)
2. Technology Gaps (Roadmap, Critical Problem/Opportunity)
3. Program/Stakeholder Needs
4. Information Gaps

Lab Project Proposals

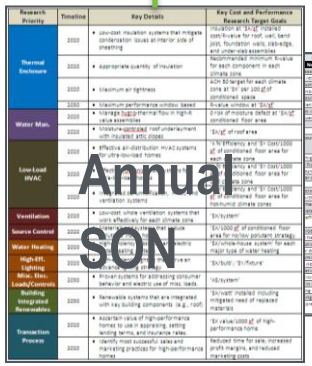
BA Team Project Proposals

DOE Select Final Project Portfolio

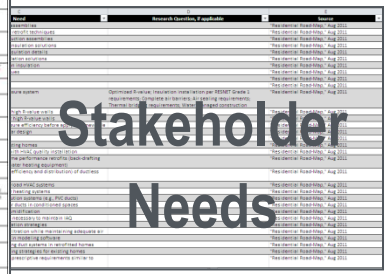
Tech Gaps



Annual Lab Reviews



Annual SON



Stakeholder Needs

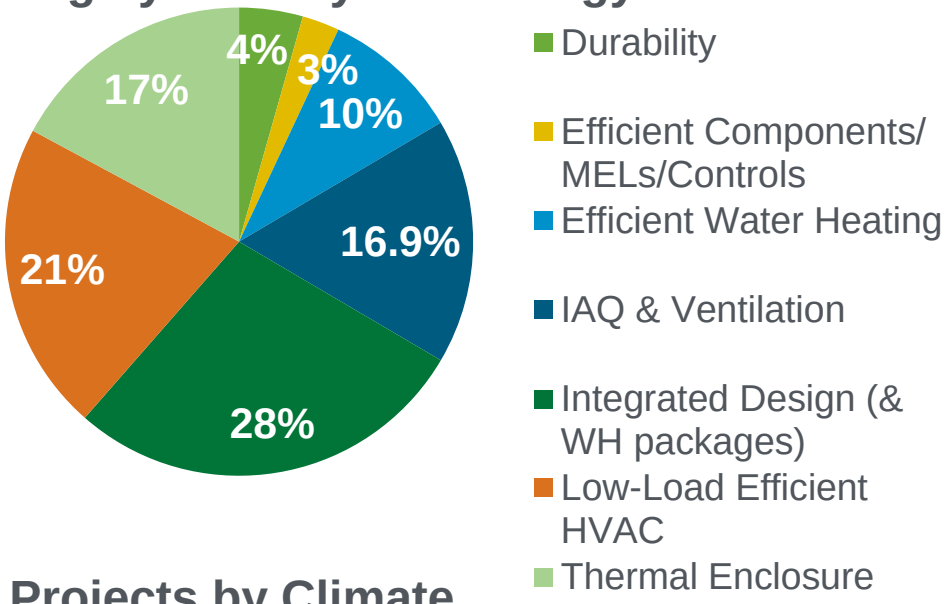
Building America
Project Portfolio Overview

- ~100 projects funded in 2014
- 50 Retrofit-focused
- 23 address Codes & Standards Innovation (CSI)
- 30 involve DOE Zero Energy Ready Homes
- 70 leverage DOE deployment partners: HPwES, WAP, BBNP

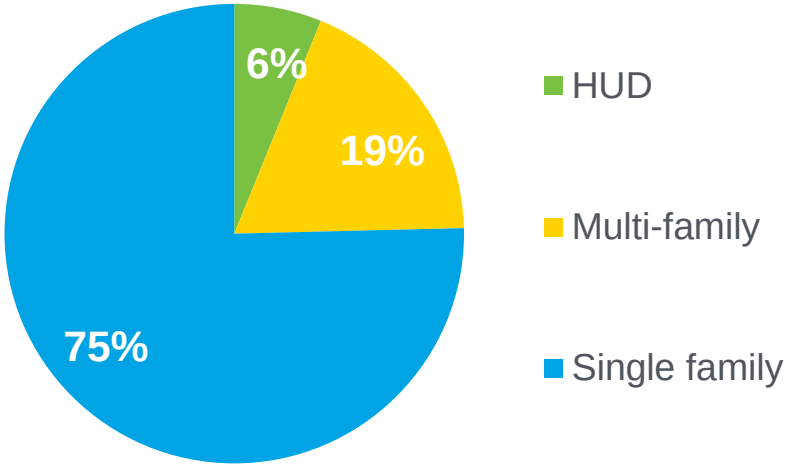
Building America Project Portfolio Overview

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

Funding by Primary Technology Area

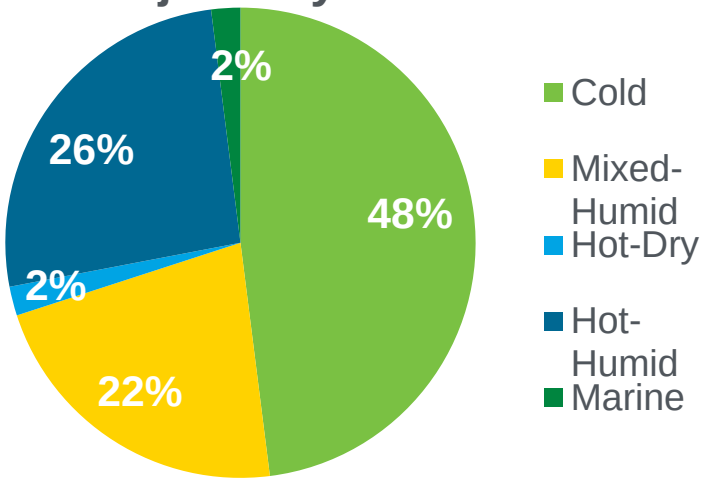


Projects by Building Sector



An additional 69 projects address all building sector types.

Projects by Climate



Introduction to 4 of 10 Building America Teams

Building AMERICA
U.S. Department of Energy

Partnership for Improved Residential Construction

BA-PIRC

UNIQUE FOCUS:

- Phased Deep Retrofits
- Hot-Humid Climate Zero Energy Ready Homes
- Affordable Housing

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

Consortium for Advanced Residential Buildings

CARB

UNIQUE FOCUS:

- Multi-family Buildings
- Cold Climate Zero Energy Ready Homes
- High Performance Home Certifications

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IBACOS®
innovation

UNIQUE FOCUS:

- Production Builder Processes
- Quality Construction Management
- HVAC System Design

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Partnership for Home Innovation

PHI

UNIQUE FOCUS:

- Reducing Transition Risks
- High-R Wall System Technologies
- Construction Industry Lab Facility

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Building America Details for Peer Reviewers

Project Summary

Timeline (this cycle):

Start date: January 2011

Planned end date: December 2014

(BA Teams operate on a CY timeline, with FY funding. This peer review covers FY13 & FY14)

Key Milestones (general BA project milestones)

1. Project Planning and Go/No-Go; previous Q3 – Q4
2. Detailed Project Test Planning & Review; Q2
3. Project Execution and Ongoing Evaluation; Q2 - Q4
4. Reporting and Communication; Q1 subsequent

Budget:

FY13 DOE $: $7,200k for all 10 BA industry partnerships (average $720k per team excluding cost share)

FY14 DOE $: $8,135k for all 10 BA industry partnerships (average $814k per team excluding cost share)

Total future DOE $: TBD (program up for re-solicitation)

Target Market/Audience:

Residential building industry stakeholders - developers, builders, trade partners, architects, whole house contractors, utilities and other program developers with focus on "above code" market actors.

Key Partners (Industry Team Leads):

ARBI	Davis Energy Group +
ARIES	Levy Partnership +
BARA	Building Media +
BA-PIRC	FSEC +
BSC	Building Science Corp. +
CARB	Steven Winter +
IBACOS	IBACOS & Alliance
NorthernStar	U. Of MN +
PARR	GTI +
PHI	Home Innovation Lab +

Program Goal:

Reduce building-related energy use by **30 percent and 25 percent, respectively, in new and existing residential building stock by 2020, and 50 percent and 40 percent by 2030.**

Purpose and Objectives

Problem Statement:

- Develop and demonstrate **market-ready** building solutions that improve the energy efficiency of new and existing homes, with increasing comfort, health, safety, and durability. Conduct research with manufacturing and building partners to verify performance of new equipment/technology and aid in the advancement of newer, better, more cost-effective options. When fully deployed, proven solutions would reduce building-related energy use by **30 percent and 25 percent, respectively, in new and existing residential building stock by 2020, and 50 percent and 40 percent by 2030.**

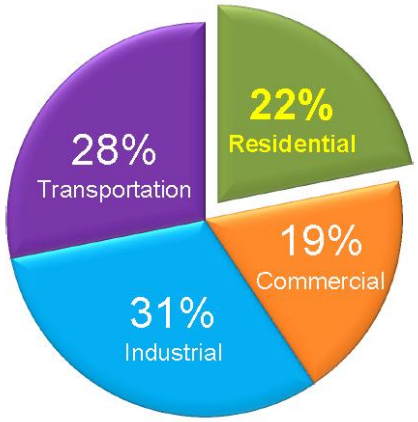
Purpose and Objectives

Problem Statement:

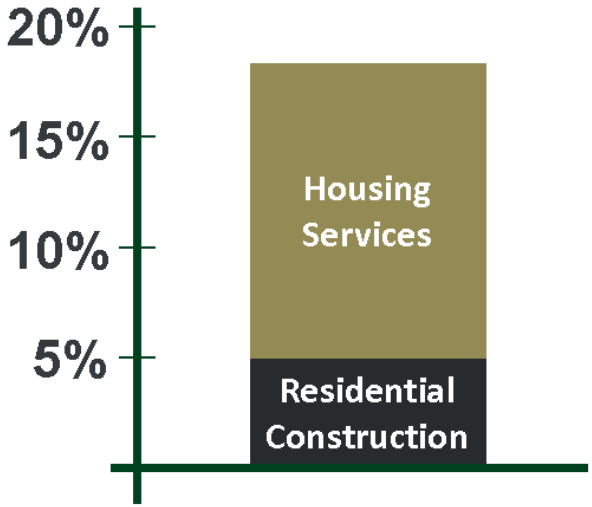
- The rate of development and adoption of systemic (as opposed to incremental) energy innovations in the residential building sector is limited by:
  - *Low industry R&D investments (especially in the systems integration of buildings)*
  - *Fragmentation of the industry*
  - *System-level risks and barriers*

Target Market

- ~116 M Residential housing units in US
- 20.14 Quads[1]
- 22% total US energy Consumption[1]
- 78% of Residential consumption is in owner occupied housing[1]



U.S. Energy Consumption



Housing Sector Percent of GNP

Source: NAHB data through Q1 2012

1) EIA Buildings Energy Data Book: 2.1 Residential Sector Energy Consumption,

Audience

At the BA program level, our audience is all residential building industry stakeholders. Teams typically engage Innovators and early adopters that want to distinguish themselves from their competition.

- This is a HUGE audience[1]

NAICS DESCRIPTION	NAICS CODE	NUMBER OF ESTABLISHMENTS (Companies, not individuals)	
		Total	<20 employees
Residential Construction	2361	150,986	147,772
Specialty trade contractors	238	392,419	349,957
Architectural, engineering, and related services	5413	98,918	74,087

1) 2009 – 201 SUSB Employment Change Data, US Census, http://www.census.gov/econ/susb/index.html Accessed MArch 20, 2014.

Planned Contribution to Energy Efficiency

End Point: Long Term **RBI** Goal[1]

- "BA program outputs **enable** 30% near-term and 50% long-term source energy savings in new and existing homes. BA teams develop and demonstrate marketable system packages that **reliably** achieve these savings targets. Successful demonstrations are documented and disseminated via technical reports, measure guidelines, the Solution Center, trade journal articles, conference presentations, webinars, and videos.

1) DOE FY 2015 Congressional Budget Request Vol. 3DOE/CF-0098, Page 246
http://energy.gov/sites/prod/files/2014/03/f13/Volume%203.pdf

Planned Contribution to Energy Efficiency

End Point: Long Term **Building America** Goals[1]

1. Solutions that support 50 percent savings in new homes, and 30 percent savings for home upgrades
2. Address indoor air quality and moisture/water management, which are critical health, durability, and comfort issues which are the secondary effects related to high performing homes
3. Examine and resolve code and market barriers associated with 1 & 2
4. Investigate various homeowner transaction processes to identify and reduce impediments to greater adoption of technologies beneficial to the homeowner

1) DOE FY 2015 Congressional Budget Request Vol. 3DOE/CF-0098, Page 246
http://energy.gov/sites/prod/files/2014/03/f13/Volume%203.pdf

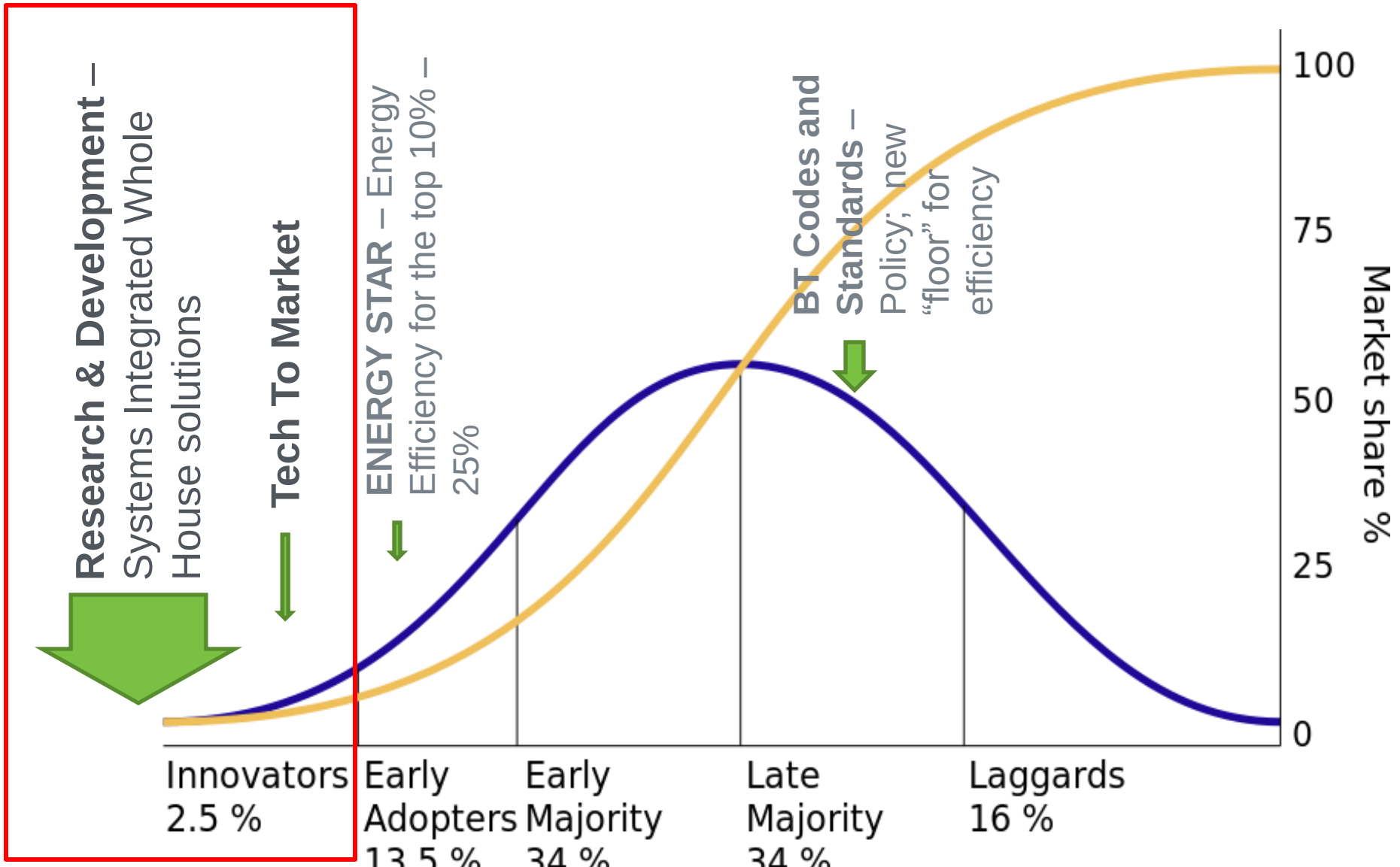
Planned Contribution to Energy Efficiency

Building America Program Goals for period covered by this peer review (2012 – 2014)[1]

- 2012: Verify 30% reduction in energy consumption (compared to IECC 2009 code for new home, current annual consumption for existing) cost effectively.
- FY 2013 Verify 30-40% reduction in energy consumption (compared to IECC 2009 code for new home, current annual consumption for existing) cost-effectively
- FY 2014 Prove 40-50% cost effective savings and integrated solutions.

1) DOE FY 2014 Congressional Budget Request Vol. 3DOE/CF-0086, Page EE-245-6
http://energy.gov/sites/prod/files/2013/04/f0/Volume3_1.pdf

Approach: BA is Residential Systems RD&D + MT



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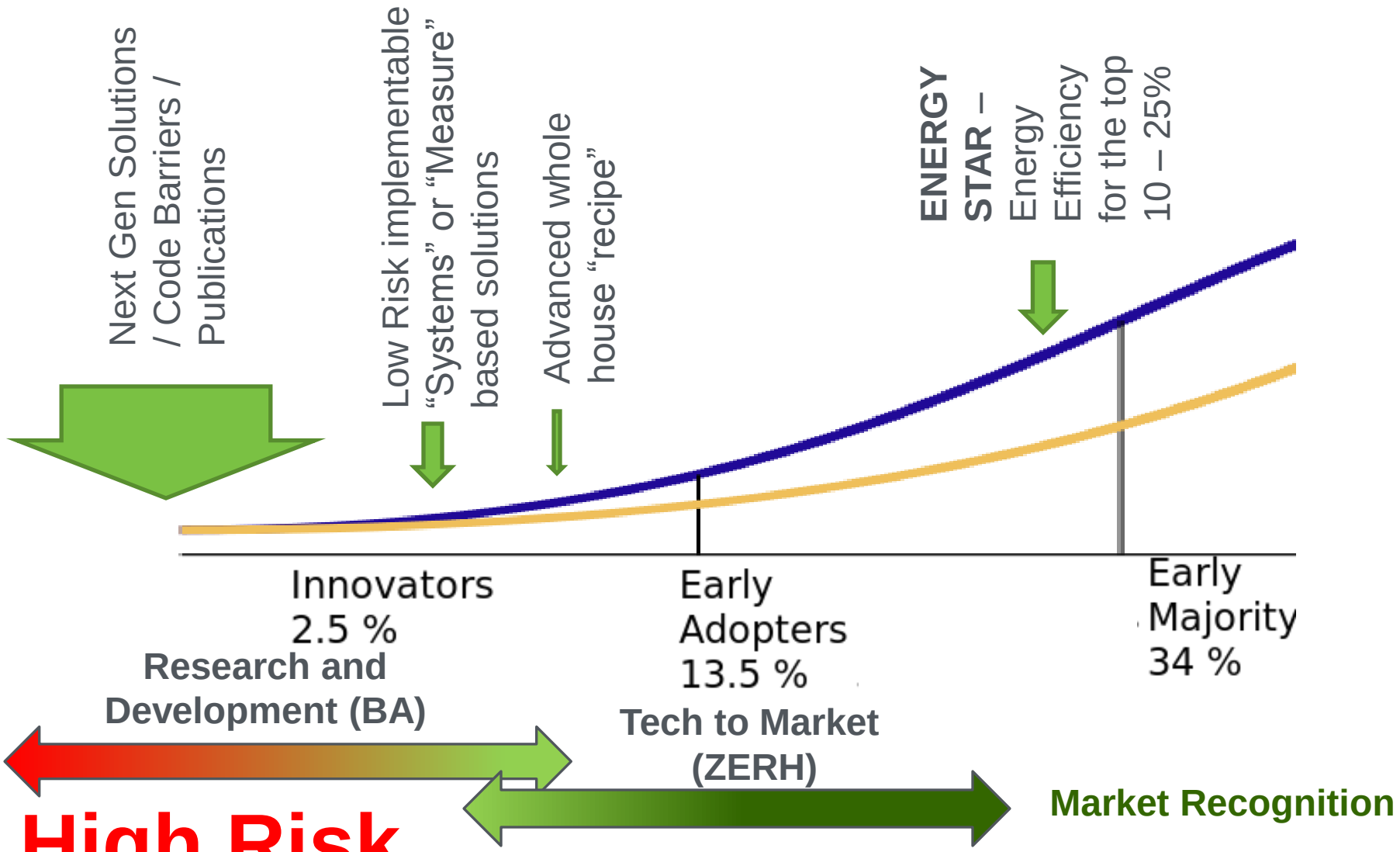
Approach: R&D and Tech to Market



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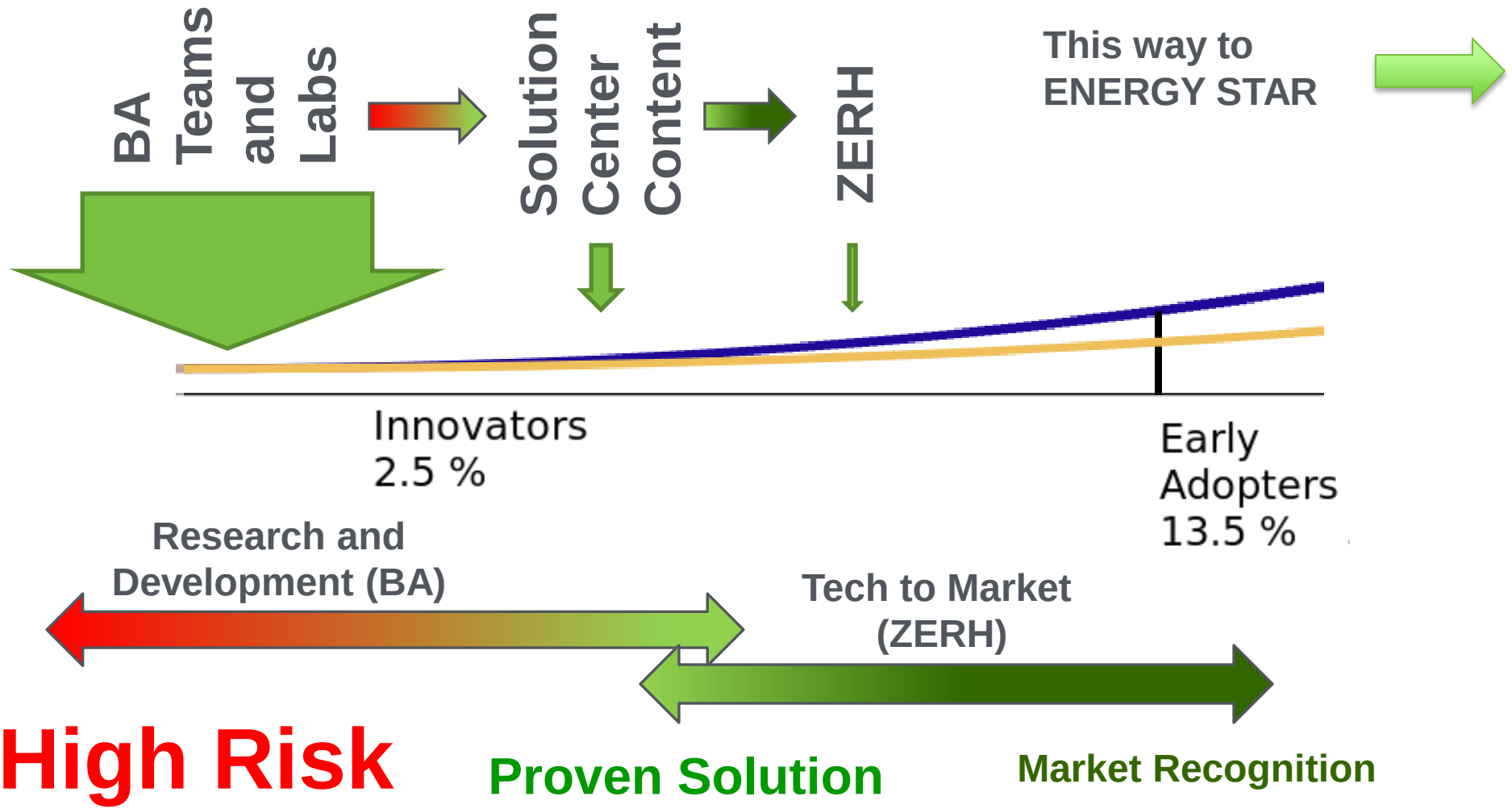
Approach: Program relationships within RBI



Approach

Approach:

- DOE – Manages Program strategy, NREL and other National Lab efforts
- NREL- Manages Teams
  - 10 competitively selected teams, 5 year task order agreement, with annual task orders to undertake work on specific projects (new or ongoing)
- Multistage research approach
  - Individual systems of component evaluations in the context of the whole house
  - Systems integrated whole house solutions – occupied or unoccupied test houses
  - Community scale evaluation – once risks / benefits are clear, can a builder adopt at scale.

Approach

Key Issues:

High level categories that have been identified and that teams are working on:

- Space conditioning strategies and systems integration for low load houses
- Hot water – efficient generation and distribution, and whole house impacts
- Thermal enclosure – efficiency, durability, constructability
- Automated home energy management
- Analysis methods and tools
- Test methods and protocols
- Business and market barriers

Approach

Distinctive Characteristics:

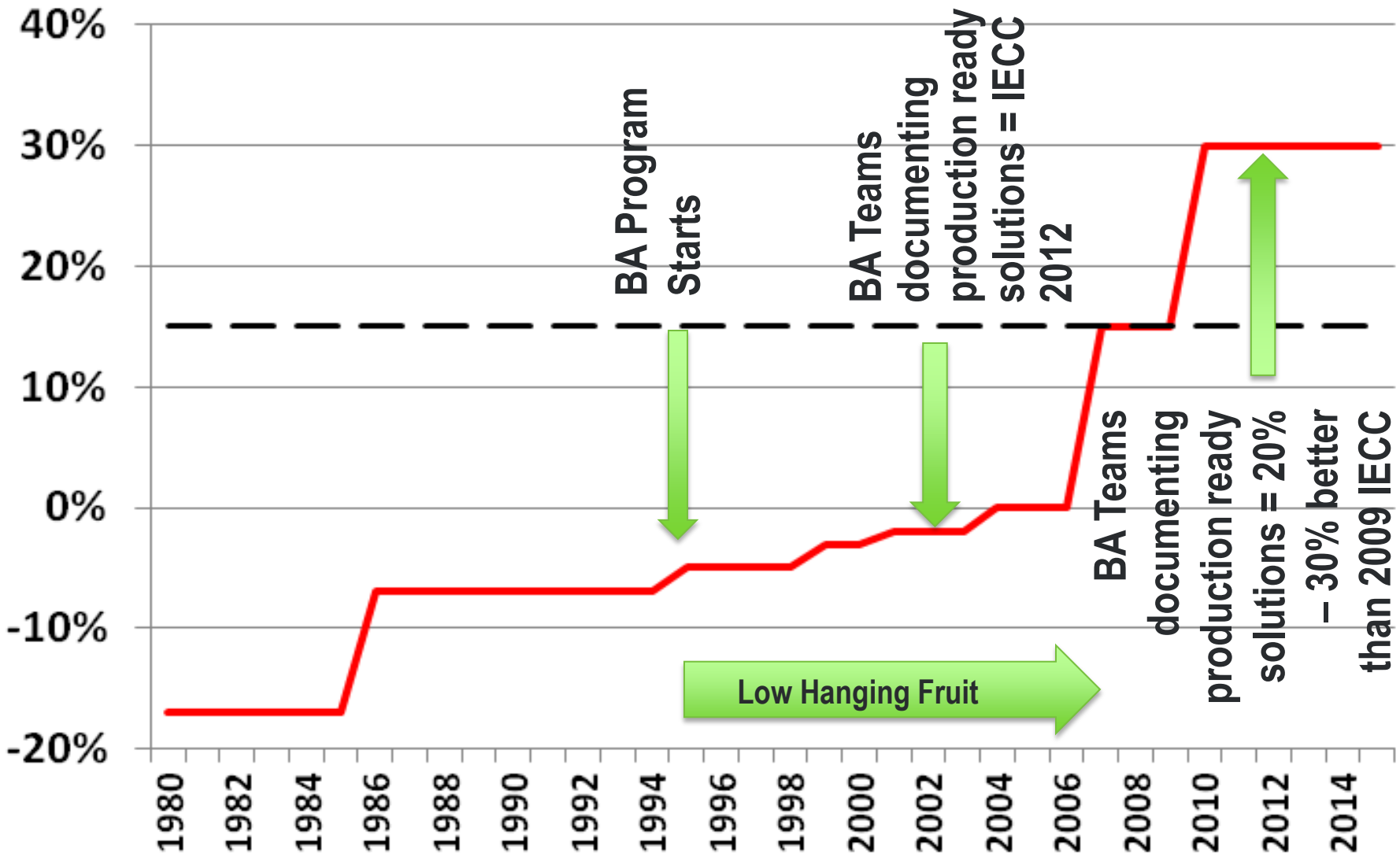
- Building America Team structure
- Building America combines advanced research resources with market "Partners" to develop real world solutions
- Partners (i.e., builders, contractors) do not receive DOE funding for equipment, materials, or labor – i.e., 100% cost share
- Building America researchers leverage manufacturers in the innovation process to engage with builders at the R&D level to understand new product innovations that may be appropriate for the market
- Teams create networks of practitioners that share lessons learned and foster new ideas – inside individual teams and across teams.
- All of this accelerates the work being done and adoption in the market

Accomplishments:

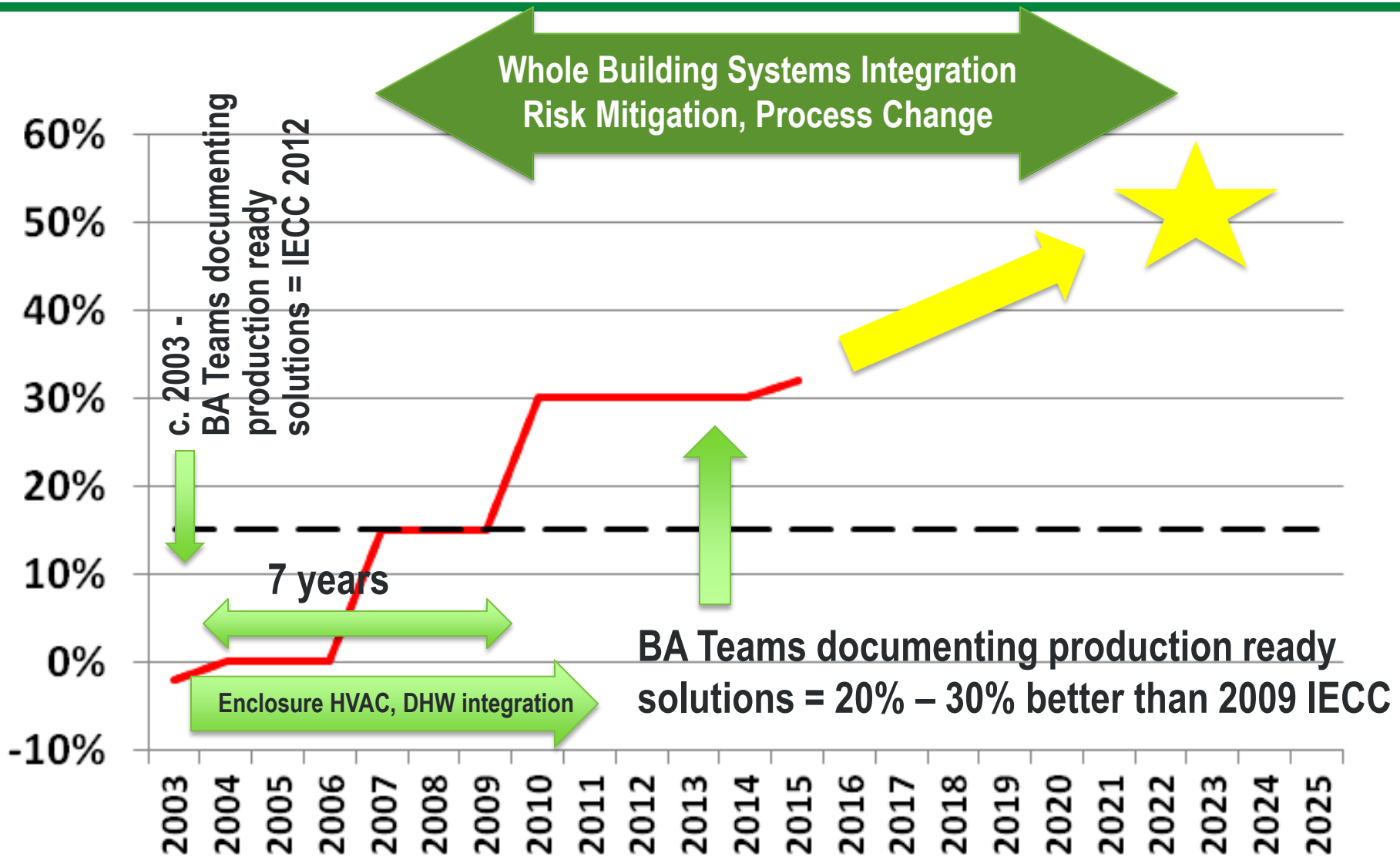
Recent Results of Building America include:

- >40 Innovations, incl. Code & Standard changes
- >**200,000** houses got HERS index in 2013 **(~ 45%** of new construction market)
- Average 2013 HERS Index is **64 (~20%** better than 2009 IECC)
- The BASC had >**161,000 page views** (>**53,000 unique visitors**) with consistent monthly averages, >**11,500 document downloads** and >500 new registered users.
- Building America pubs downloaded by >**45,000 users in 2013**.

Project Contribution to Energy Efficiency



Project Contribution to Energy Efficiency



Progress and Accomplishments

Awards/Recognition: Building America Top Innovations selected each year. Examples…

1. **Market-ready Zero Energy Ready homes** and successful related high performance labeling programs. The DOE Challenge Home and its predecessor, the Builders Challenge, recognize and promote hundreds of leading builders for their achievements in energy efficiency. These programs have resulted in over 14,000 homes that are 40-50% more efficient than homes built to code, creating millions of dollars in energy savings and paving the way for zero energy homes.

Progress and Accomplishments

Awards/Recognition: Building America Top Innovations selected each year. Examples…

- Simple, cost-effective **techniques for providing fresh air throughout the home**, namely: (1) the required mechanical ventilation to bring in fresh air and to exhaust stale air; and (2) ways to enable cost-effective, reliable ventilation systems that simply didn't exist when Building America researchers began their work. Building America teams developed simple fresh air ventilation systems that cost less than $350 to install, that have become typical practice in Millions of homes, enabling tighter more efficient homes.

Progress and Accomplishments

Awards/Recognition: Building America Top Innovations selected each year. Examples…

3. **Cost-effective wall insulation solutions** that reduce energy losses and prevent moisture damage. Building America developed proven solutions for builders across the country, to help them design and install thicker (higher R-value) wall insulation systems that work and don't leak cold or hot humid outside air like typical walls.

Progress and Accomplishments

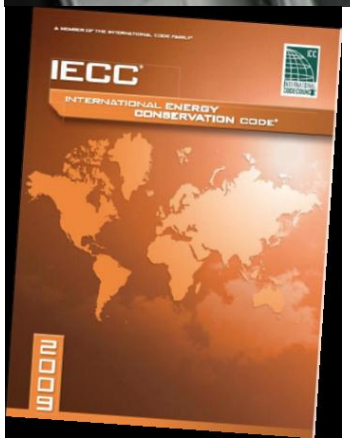
Awards/Recognition: Building America Top Innovations selected each year. Examples…

4. **Technical solutions for sealing and insulating ducts** in new and existing homes. Ducts typically result in thermal losses of 10% to 45% of total space conditioning energy use; Building America solutions can reduce the losses to 3% or less.

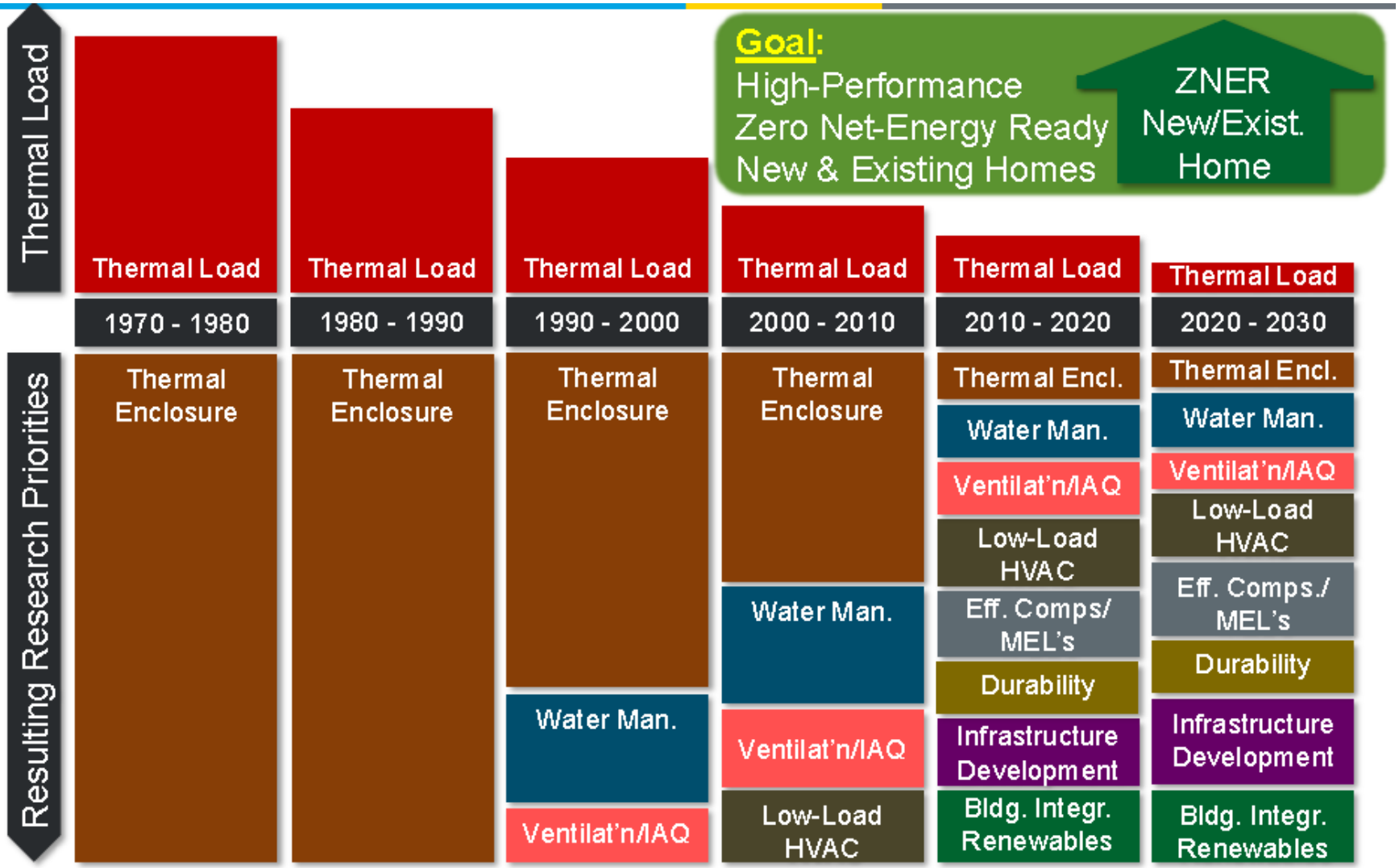
Progress and Accomplishments

Awards/Recognition: Building America Top Innovations selected each year. Examples…

5. **Technical innovations in program standards and building codes**, such as:
   - Standards for rating furnace blowers in Federal tax credit programs and energy codes, and Federal rulemaking procedures
   - Air barrier details led to **inclusion of thermal bypass air barriers** in ENERGY STAR for Homes Version 2 specifications in IECC 2006/2009,
   - A **standard for home performance-related data transfer** (HPXML), estimated 20% reduction in overhead costs for participation in high-performance home programs.



Next Steps and Future Plans



REFERENCE SLIDES

Project Budget

Project Budget: Building America is a multi-year research program. FY13 and FY14 face-value contract amounts have been summarized here (excluding overhead burden and management).
Variances: Budgets are executed as planned.
Cost to Date: Projects are accrued linearly and managed on a calendar year cycle. For FY14, approximately 30% of project cost has been accrued.
Additional Funding: All BA team contracts have at least 20% cost-share from industry partners.

Budget History					
January 2013 – FY2013 (past)		FY2014 (current)		FY2015 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$7,200k	>20%	$8,135k	>20%	TBD	TBD

Project Plan and Schedule

Building America Team Project Planning and Execution:

- BA teams are funded under a multi-year Task Ordering Agreement managed by NREL. Project portfolios are selected on an annual basis. 2014 is the final year of this agreement.
- All BA Teams go through rigorous annual project proposal and review process, including review and coordination by NREL technical and DOE program management.
- Each project has the following deliverables: detailed test plan, report, case study and BA Solution Center content. Test plans are reviewed by technical program managers and all other publications undergo a peer review process before being communicated to the broader residential industry.