Building Technologies Office

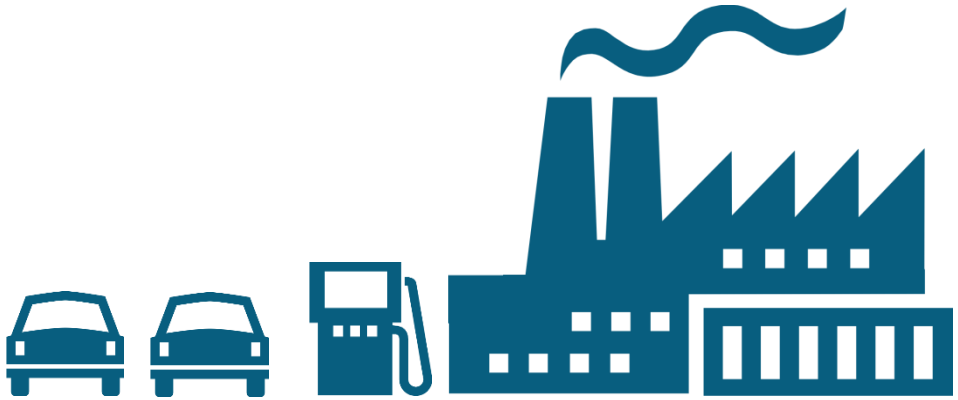
Richard Karney, P.E.

May 8, 2014

National Energy Consumption

40%

60%



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Reducing consumption or improving performance calls for
cutting-edge
energy-efficient
solutions

Aiming High for 2030

Double U.S. energy productivity

Lower building energy use by 50%

- Annual energy use by 20 quads
- 1 billion metric tons CO_2
- $200 billion

for America's

homes and **buildings**

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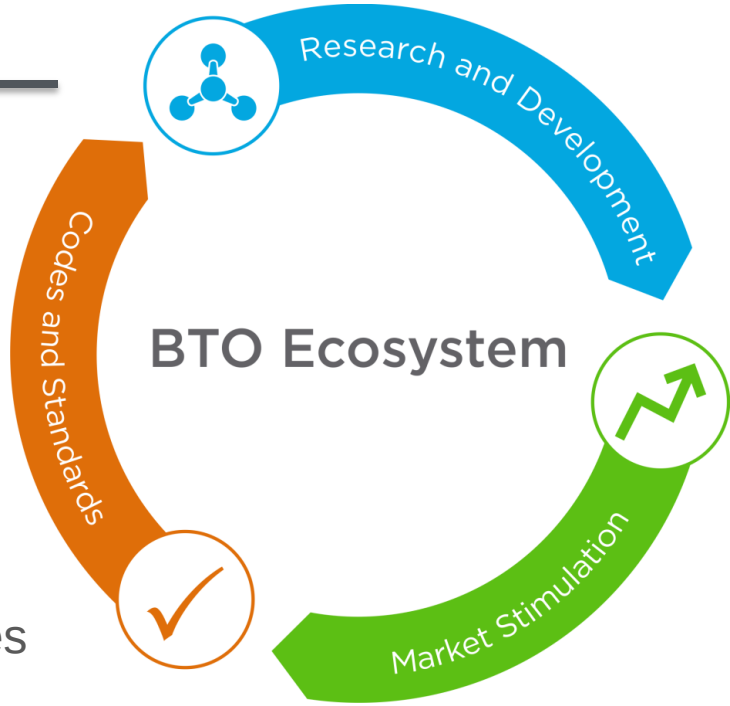
Delivering Energy-Efficient Solutions



Emerging Technologies

- High-impact building technologies
- ~Five years to market-ready

Residential Building Integration

- Cost-effective technologies, tools, solutions
- Peak energy performance in new & existing homes

Commercial Building Integration

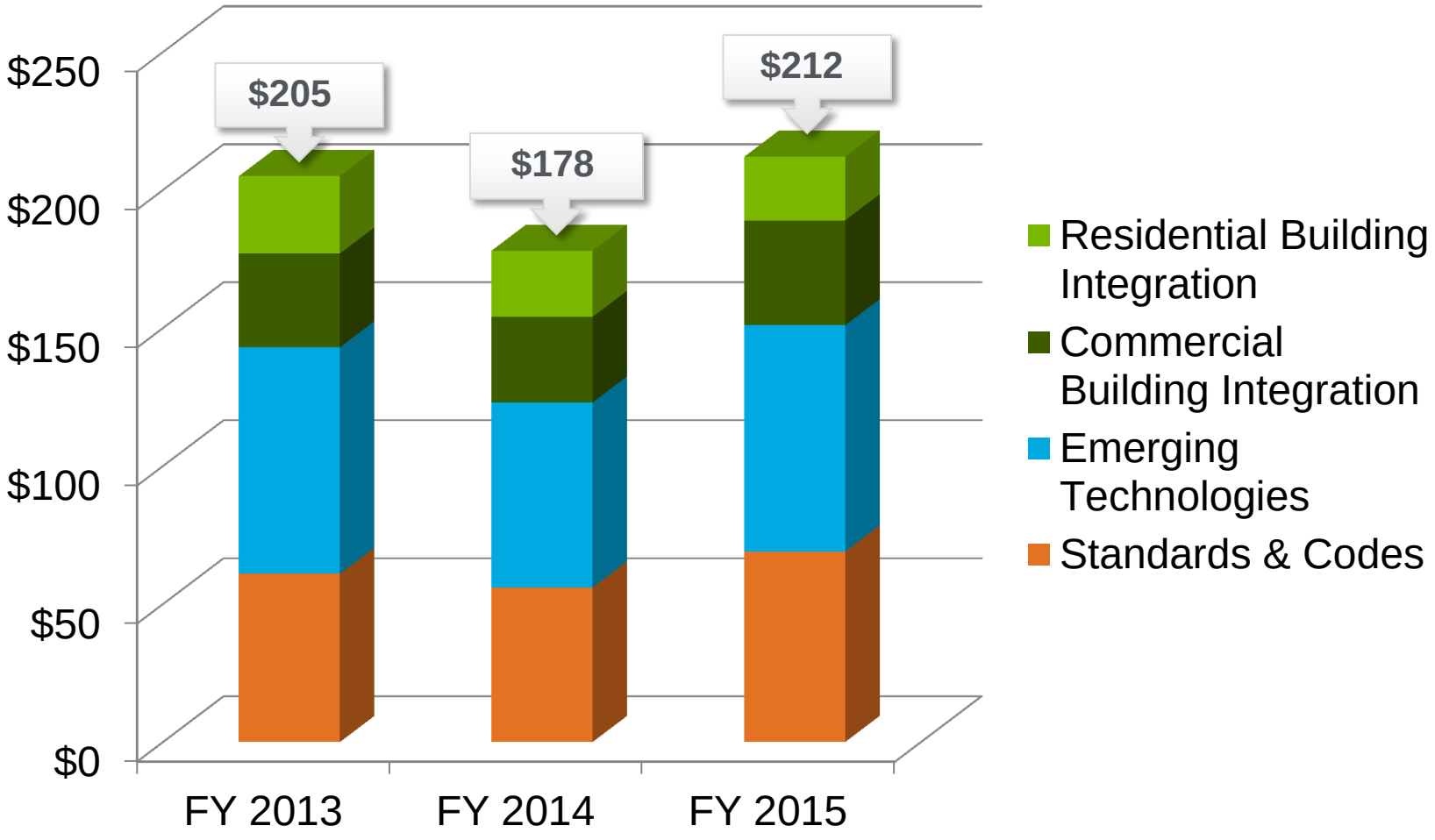
- Cost-effective technologies, tools, solutions
- Peak energy performance in new & existing commercial buildings

Codes & Standards

- Building energy code language with adoption/compliance strategy
- National appliance & equipment standards

BTO Funding by Program

(in millions)




Research and Development
Drive
Innovation
U.S. DEPARTMENT OF
ENERGY
Energy Efficiency &
Renewable Energy

R&D Emerging Technologies

Opportunity

Develop **high-impact technologies** with **50%** energy savings

Strategy

Identify high-impact technologies with the **Prioritization Tool** **&** **Fund R&D** through competitive solicitations and support National Lab technical capabilities

65%

34%

24%

Potential - Energy - Savings

29%

37%

18%

Emerging Technologies (ET) Mission

The Emerging Technologies (ET) Program's Mission:

Supports applied research to accelerate the development and initial commercialization of technologies and systems capable of substantially reducing primary energy use through improved:

- Solid-State Lighting (**Jim Brodrick**)
- HVAC, Water Heating and Appliances (**Tony Bouza**)
- Windows & Envelope (**Karma Sawyer**)
- Sensors and Controls (**Joe Hagerman**)
- Building Energy Modeling (**Amir Roth**)

Tech-to-Market & SBIR programs are managed by **Bahman Habibzadeh**.
George Hernandez serves as the Chief Engineer.
Leon Fabick and **Jim Payne** are Technical Project Officers based in Golden, CO.

ET Mid-term and Long-term Goals

Goals: Emerging Technologies	Mid-term (2020)	Long-term (2030)	Potential Energy Savings in 2030 (TBTU Saved)
Lighting	33%	65%	4,318
HVAC	12%	24%	2,934
Water Heating	19%	37%	1,484
Appliances	14%	29%	2,571
Envelope (Opaque)	12%	25%	3,048
Windows	4%	9%	1,102
Sensors and Controls	9%	18%	2,214

Goals: Emerging Technologies	Mid-term (2020)
Building Energy Modeling	Double gross square footage designed with the help of building energy models.

The BTO Prioritization Tool (P-tool) was used to generate these energy savings potential numbers which assume maximum adoption potential.

ET Barriers & Strategies

Key Barriers

- High cost or limited performance of commercially available technologies.
- Inadequately funded private research.
- Lack of efficiency test protocols or reliable information on performance of new technologies.
- Market barriers to introduction of new technologies.

Strategies

- Engage industry stakeholders in sector and technology analyses to select cost and performance targets and identify emerging opportunities.
- Fund competitively selected research and development efforts to achieve key targets of technology roadmaps/MYPPs and fund "off-roadmap" technologies & approaches.
- Dedicated support to develop design tools and standardized test methods, and to support technology commercialization.
- Competitively selected and merit reviewed research to fill gaps in MYPP and to support early stage, exploratory R&D.


Market Simulation
Accelerate
to Scale

Market Stimulation Residential Buildings

Opportunity: Existing Homes

50% energy reduction via **retrofits**

Opportunity: New Homes

50% energy reduction, **Zero-Energy Ready**

Strategy

- **Demonstrate** technologies to spur integrated solutions
- **Deploy** standardized data tools to assess performance, show value
- **Develop** guides to inform construction industry

Residential Buildings Integration (RBI) Mission/Vision

The Residential Buildings Integration (RBI) program's mission:
To accelerate energy performance improvements in residential buildings by developing, demonstrating, and deploying a suite of cost-effective technologies, tools, and solutions to achieve peak performance in new and existing homes.

RBI Vision, by 2030:

- Cost-effective whole house solutions will become standard practice markets.
- Most new homes will be Zero Energy Ready, meeting *high performance specifications* that ensure comfort and acceptable IAQ, and use at least 50% less energy than 2010 benchmark.
- There will be robust, competitive markets for home improvements that, if delivered as a whole house retrofit, provide better home comfort, IAQ, and cost-effective energy savings that average 50% or more per house.
- Industry standards and building codes will advance to ensure energy savings at national scale, following voluntary adoption by market leaders.

RBI Mid-term and Long-term Goals

	Goals: Residential Buildings Integration	
Existing Buildings	**Mid-term (2020)**	Demonstrate at scale the reduction of energy use of typical homes by an average of 20%, while improving overall indoor air quality, durability and comfort.
	Long-term (2025)	Demonstrate at scale the reduction of energy use of typical homes by an average of 25%, while improving overall indoor air quality, durability and comfort.
New Buildings	**Mid-term (2020)**	Demonstrate at scale the reduction of energy use of new homes by 30%*, while improving overall indoor air quality, durability and comfort.
	Long-term (2025)	Demonstrate at scale the reduction of energy use of new homes by 50%*, while improving overall indoor air quality, durability and comfort.

***Baseline: 2010 or IECC 2009 (for new)**

RBI Barriers & Strategies

Key Barriers

Home energy use is very complex with multiple technology/system interactions and significant uncertainty about energy drivers.

Fragmented industry under-funds research of whole-building energy efficiency and performance, and is highly risk averse.

Owners lack feedback on home performance and have limited tools to effectively address high utility bill problems.

Markets have limited capability to deliver cost-effective energy efficiency services for high performance new or existing homes.

Strategies

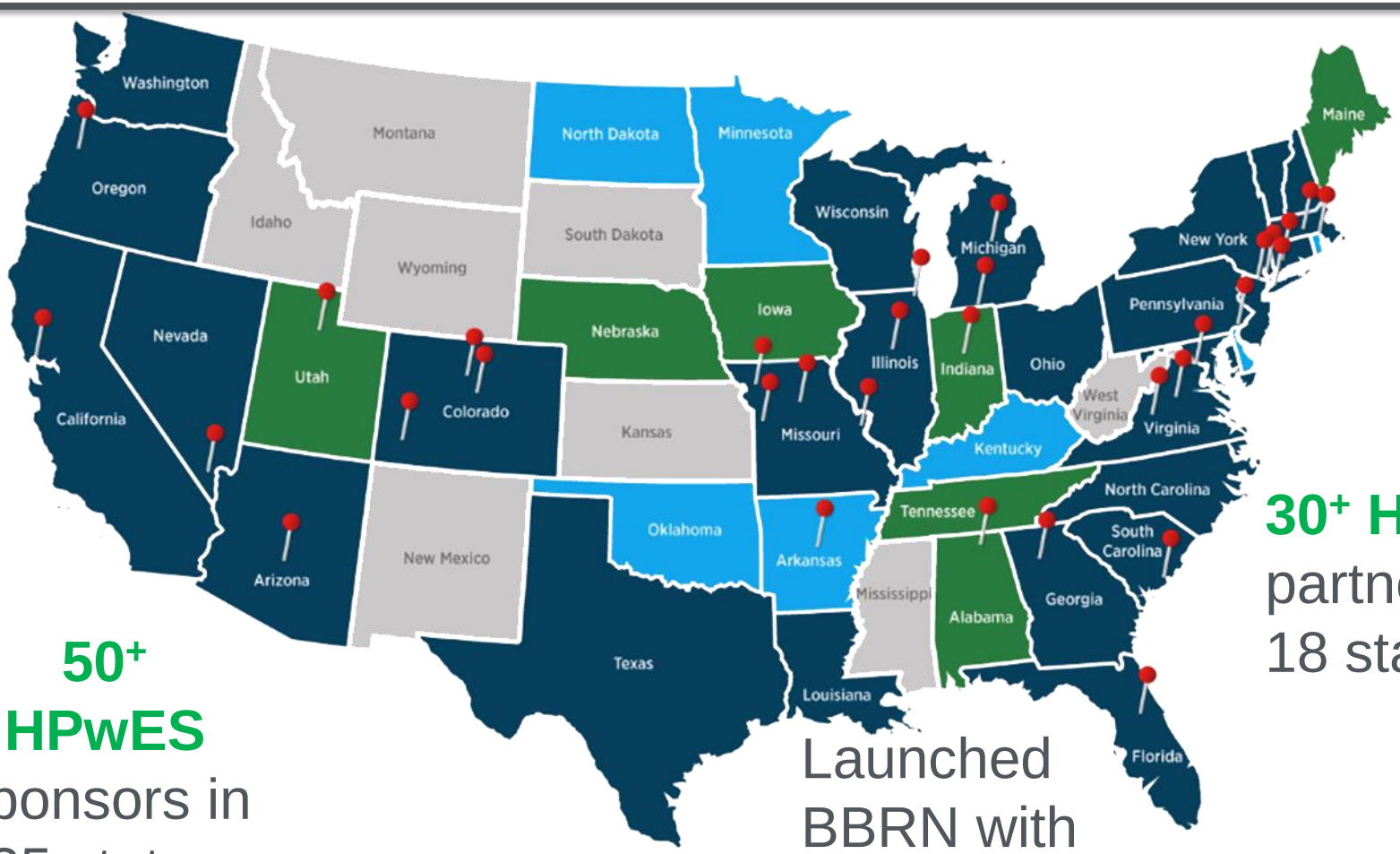
Technical Solutions: Develop and demonstrate advanced technologies & practices that enable profitable Zero Energy Ready new homes and whole house retrofits.

Capacity Building: Develop and disseminate effective guidance & training for building sector professionals and other service providers.

Tools and Information: Develop and deploy tools and data that help stakeholders measure and value energy efficiency.

Private Sector Partnerships: Promote solutions and business models through market-based voluntary programs.

Better Buildings Residential *Nationwide*



50+ HPwES sponsors in 35 states

Launched BBRN with **60+** members

30+ HES partners in 18 states

Better Buildings Neighborhood Program Partner & Home Performance with ENERGY STAR Program Sponsor

Better Buildings Neighborhood Program Partner

Home Performance with ENERGY STAR Program Sponsor

Home Energy Score Partner

Better Buildings

HOME PERFORMANCE WITH ENERGY STAR

Better Buildings

HOME PERFORMANCE WITH ENERGY STAR

U.S. DEPARTMENT OF ENERGY Home Energy Score

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Market Stimulation Commercial Buildings

Opportunity: Existing Buildings

50% energy reduction

Opportunity: New Construction

50% energy reduction, **Zero-Energy Ready**

Strategy

- **Demonstrate** cost-effective & high-impact technologies & solutions
- **Deploy** tools & solutions through partnerships with building owners & operators
- **Develop** tools to
  - Influence decision making
  - Inform policy & program design
  - Demonstrate economic & environmental benefits of energy efficiency

Commercial Buildings Integration (CBI) Mission/Vision

CBI Mission

Accelerate voluntary uptake of significant energy performance improvements in existing and new commercial buildings.

CBI Vision:

A commercial buildings market where energy performance is a key consideration during construction, operation, renovation, and transactions, and net zero energy ready commercial buildings are common and cost-effective.

CBI Mid-term and Long-term Goals

Existing Buildings	**Mid-term (2020)**	Demonstrate that it is cost-effective to reduce energy use of typical commercial buildings by 20%.
	Long-term (2030)	Demonstrate that it is cost-effective to reduce energy use of typical commercial buildings by 50%.
New Buildings	**Mid-Term (2020)**	Demonstrate that it is cost effective to construct commercial buildings that use 50% less primary energy than ASHRAE 90.1, 2004.
	Long-Term (2030)	Demonstrate that it is cost effective to construct commercial buildings that are net zero energy ready.

- Demonstrate is applicable to new and existing building types that account for 80% of commercial energy consumption in all climate zones.
- Cost-effective is based on a life cycle assessment and/or relevant market-driven economic criteria.
- Unless otherwise stated, percentages are averages over a suite of solutions that when fully deployed, would reduce energy use of typical U.S .commercial buildings from a 2010 baseline as defined by AEO.

CBI Barriers & Strategies

Key Barriers

- Lack of reliable information on costs and likely impacts of efficiency measures.
- Efficiency investments perceived as too expensive or complicated / risky to access internal or external capital.
- Current real estate, design, construction and building services markets do not appropriately value energy efficiency.
- Inadequate training or experience of building services workforce

Strategies

- Provide reliable information about high impact technologies (HITs) and systems through real world demonstrations and deployment activities.
- Develop & deploy low-cost, standardized, interoperable tools that help stakeholders understand the value of energy efficiency.
- Provide design and decision support resources for new and existing commercial buildings.
- Prepare the workforce to design, build and operate buildings more efficiently.
- Engage market leaders through partnership programs.
- Support development of new, integrated program models for building retrofit.

Commercial Buildings Adv. Rooftop Unit Campaign

The Challenge

Widespread market adoption of highly efficient RTUs

Demonstrate/Deploy

Meet specifications

Reap Rewards

Save up to **50%** on energy costs

If Energy Efficient RTUs replaced all 10-20 ton commercial units, businesses would save $1 billion/year on energy

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Market Stimulation Digital Tools & Solutions

Data Sources

- Basic Building Info
- Energy Consumption
- Audits
- Commissioning studies
- Operating characteristics
- Equipment & asset info
- Public records

Tools & Databases

ENERGY STAR® Portfolio Manager®

Home Energy Score

Comm. Building Energy Asset Tool

Other Tools

Aggregation Platforms

SEED Platform

DOE BUILDINGS PERFORMANCE DATABASE

Data on 745k real buildings

Building America Solution Center

1.25 million users

EnergyPlus

24k downloads in 2013


Codes and Standards
Lock-In
Savings

Appliance & Equipment Standards

Opportunity

By issuing 12 final rules establishing new or updated energy conservation standards by the end of FY15, **BTO could deliver energy savings of 9 quads total by 2030**.

Strategy

- Increase the # of covered **products**
- Enhance product **test** procedures
- Employ **consensus** process
- Accelerate **rulemaking** schedule
- Enforce manufacturer **compliance**

All standards currently in effect stand to save…

	Cumulative by 2030
Energy	Total energy savings of 124 quads
Environment	Total CO_2 savings of 6.7 billion metric tons
Consumer	Total savings of $1.7 trillion

Building Energy Codes

Opportunity

With continued BTO efforts on the development, adoption, & compliance of the national model energy code, by 2030 the nation can achieve annual savings of: **1.26 quads of energy, $7 billion, and 94.5 MMT CO_2.**

Strategy

- Code changes analysis
- State adoption assistance
- Cost & energy savings analysis
- Compliance software

Codes Cumulative Impact from 2013 Baseline

	By 2030
Energy	Total energy savings of 12.3 quads
Environment	Total CO_2 savings of 871.1 million metric tons
Consumer	Total savings of $125.7 billion

BTO Ecosystem at Work

	Yesterday	Today	Tomorrow
Research & Development			
Market Stimulation	 Limited Delivery	 Tools & Programs	 Market Transformation
Codes & Standards	 No Codes	 IECC 2009/12	 90% Compliance

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BTO Operational Focus Areas

Logic Models

Define

Goals
Approach to work
Evaluation methods

Multi-Year Program Plans

Plan

A roadmap of program milestones

Impact Assessments

Assess

The impact of select programs

BTO Logic Model

The Chain of Logic:
How does what we produce affect the market?

Goal

- By 2020, develop HVAC technologies enabling 12% savings based on their maximum-adoption potential

Output

- Products and components ready for commercialization that meet the cost and performance targets identified in the technology roadmaps

Outcomes

- Products and components are produced and commercialized by manufactures
- Consumers and businesses purchase energy efficient HVAC equipment

Impact

- Primary energy usage due to HVAC equipment is less than would have been in the absence of the BTO HVAC program

Multi-Year Program Plan

Five Year Program Plans

2030

Reduce building energy use by 50%

Evaluation and Impact Assessment

Release RFP for Third-Party Evaluation before end of FY14

Evaluate the impact of select programs/activities

✓ Assessments complete in late FY15

BTO 2014 Peer Review

Evaluate project performance

✓ Incorporate feed back into FY 15 planning

Thank You and For More Information

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Better than me:

http://energy.gov/eere/efficiency/buildings