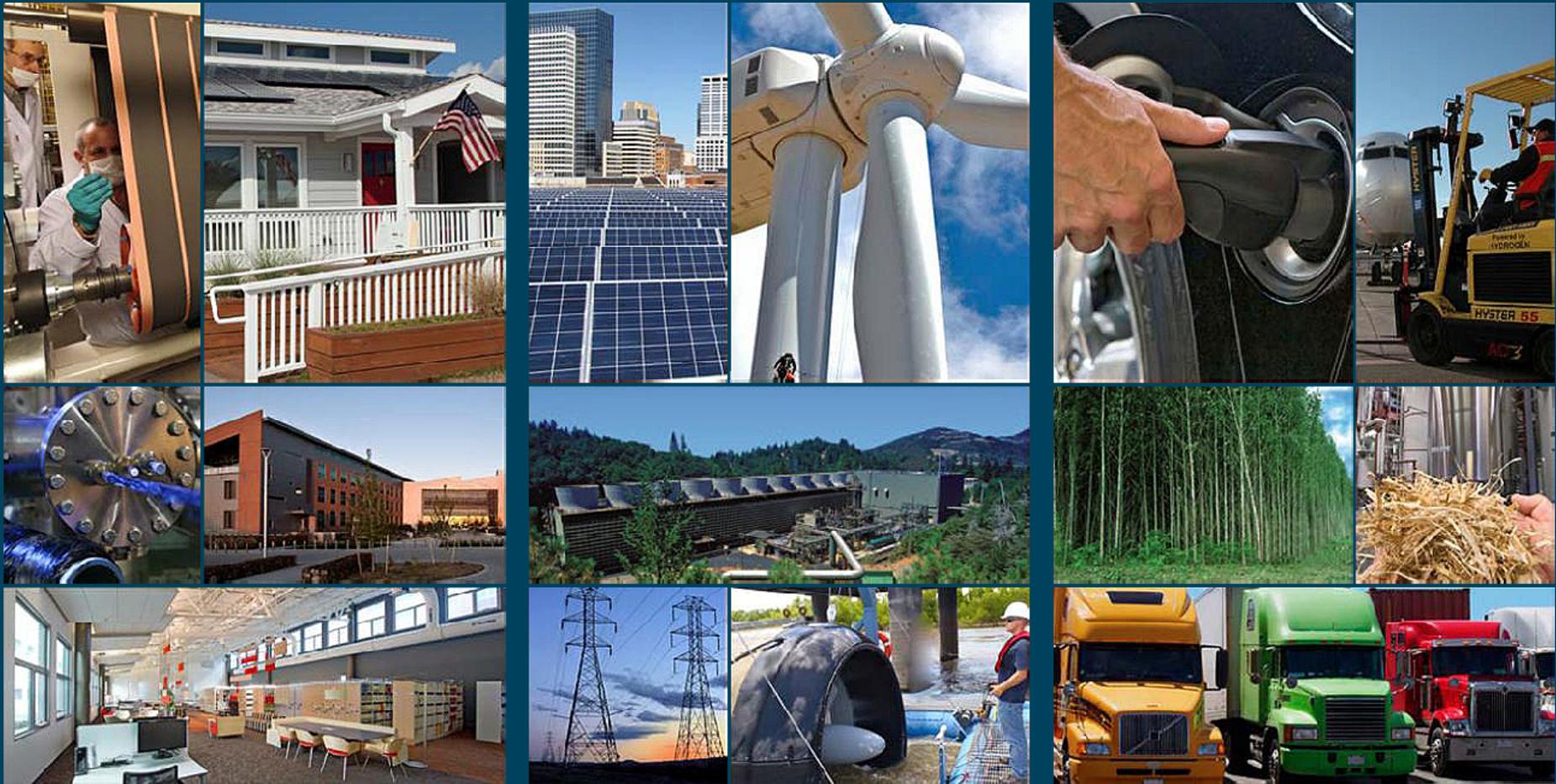


Building Technologies Office Overview



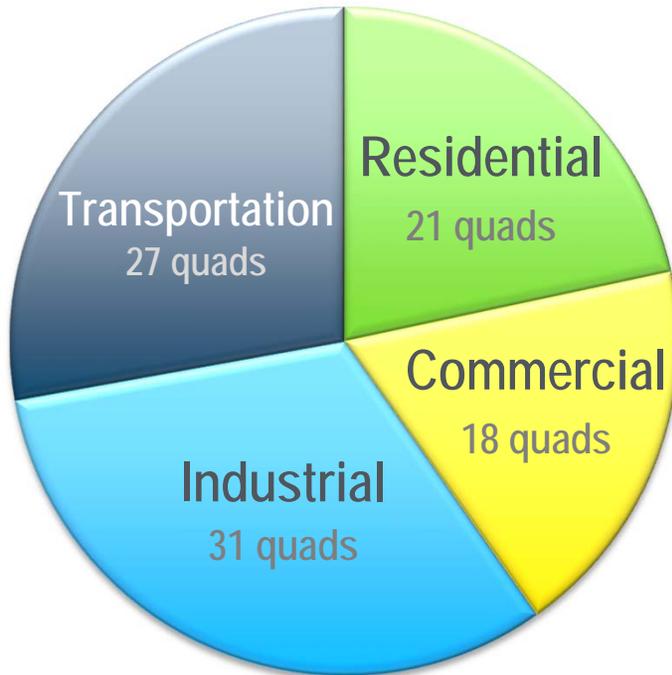
U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy

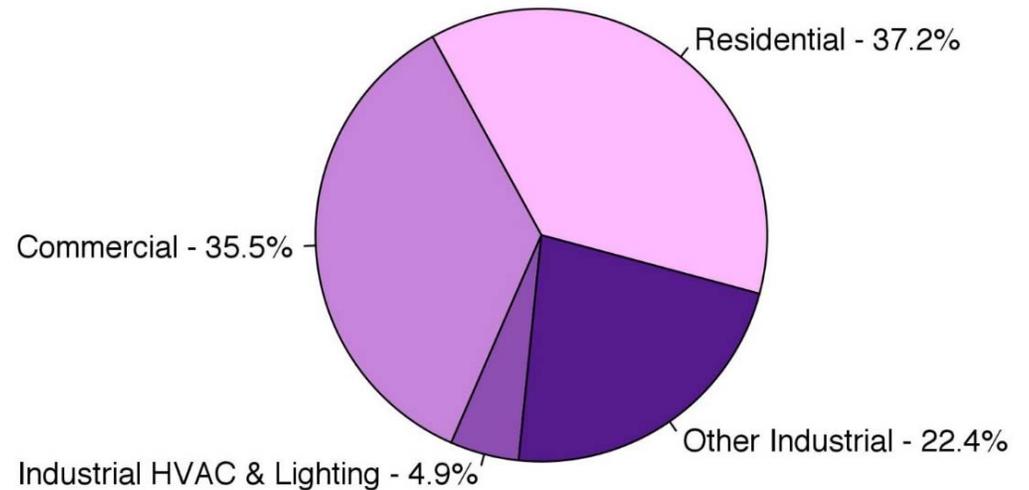
Roland Risser
Director, Building Technologies Office

**Our Homes and Buildings Use
40% of Our Nation's Energy and 75% of Electricity**

Energy Use



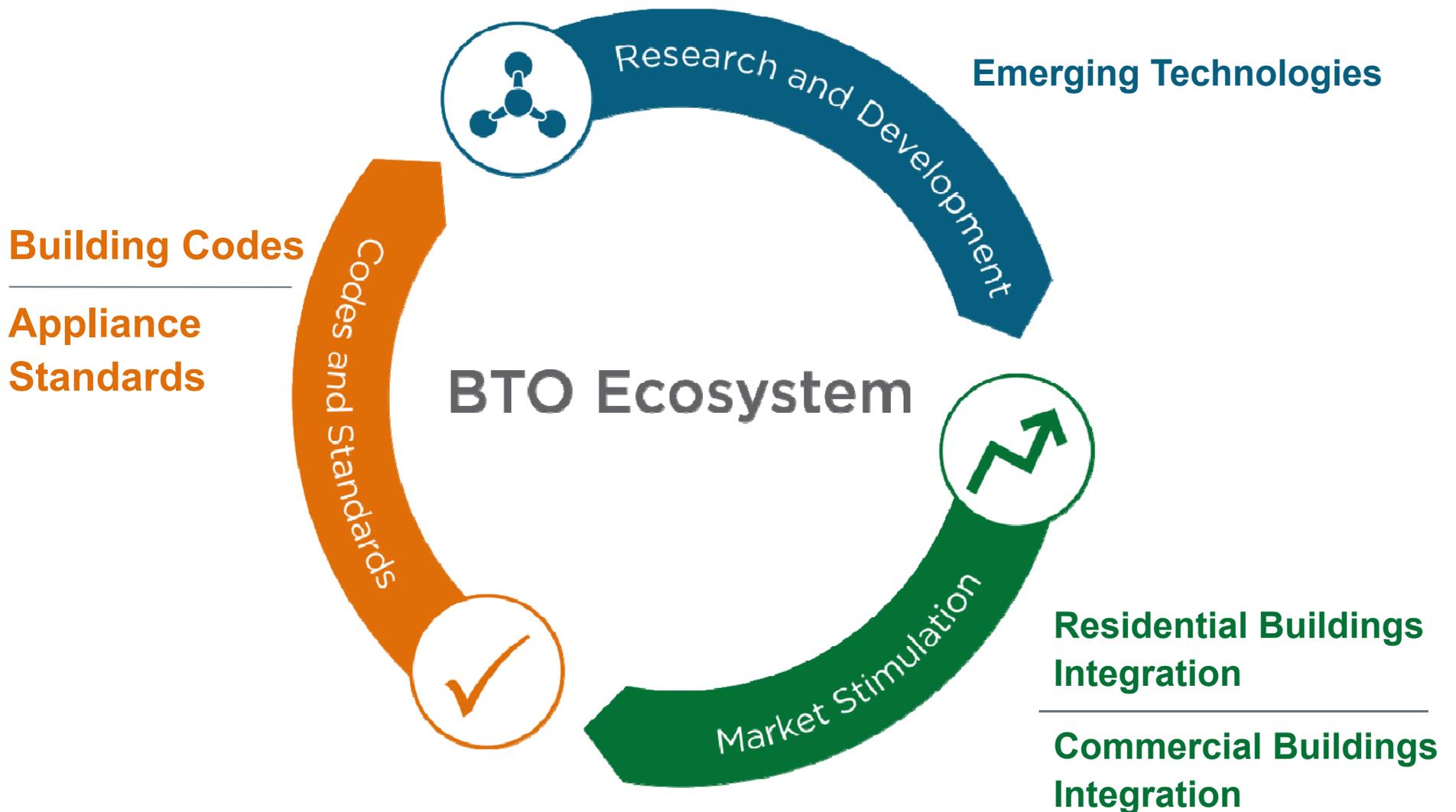
Electricity Use



* Industrial HVAC and lighting data based on 2006 MECS

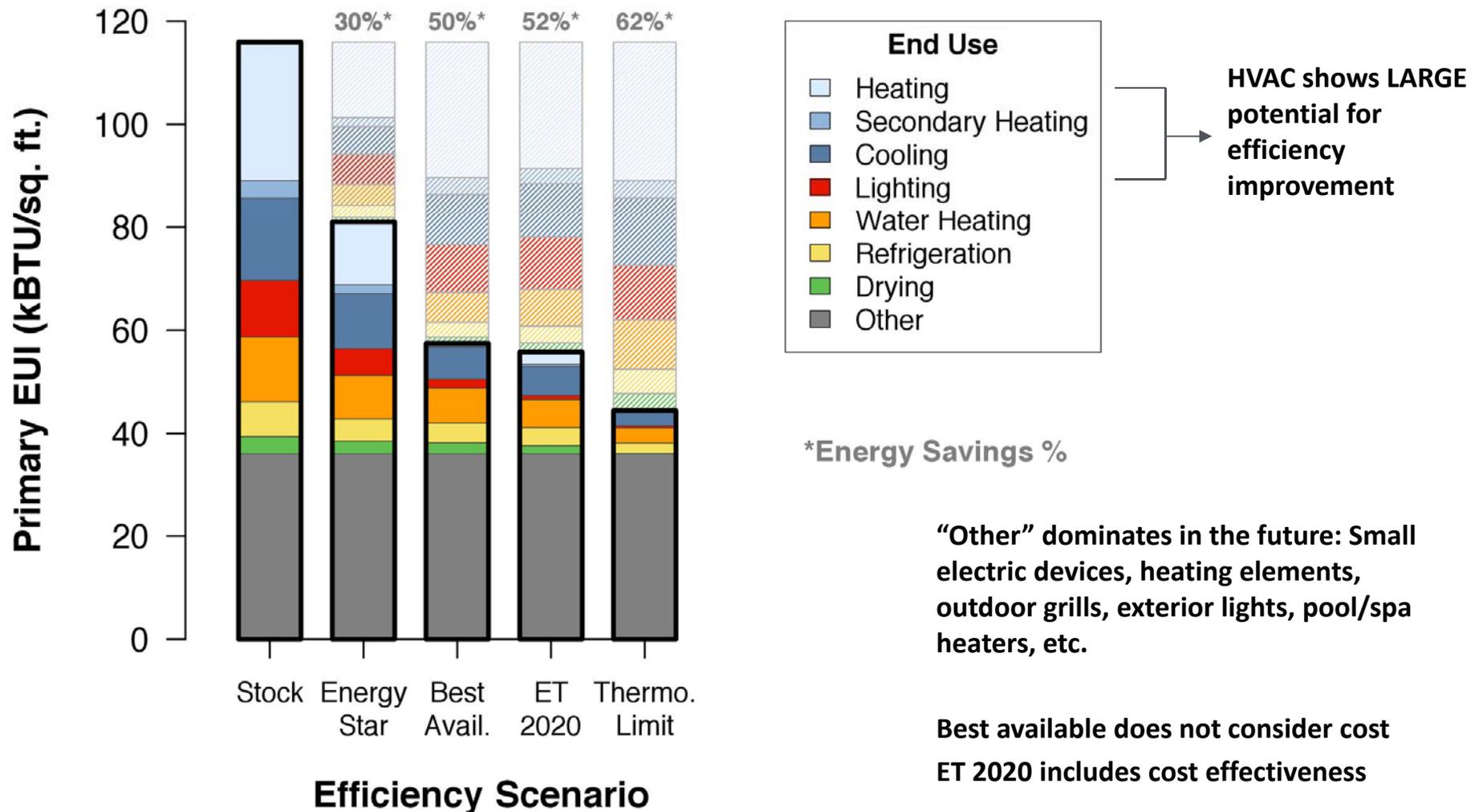
**U.S. Energy Bill for Buildings:
\$410 billion per year**

Building Technologies Office (BTO) Ecosystem



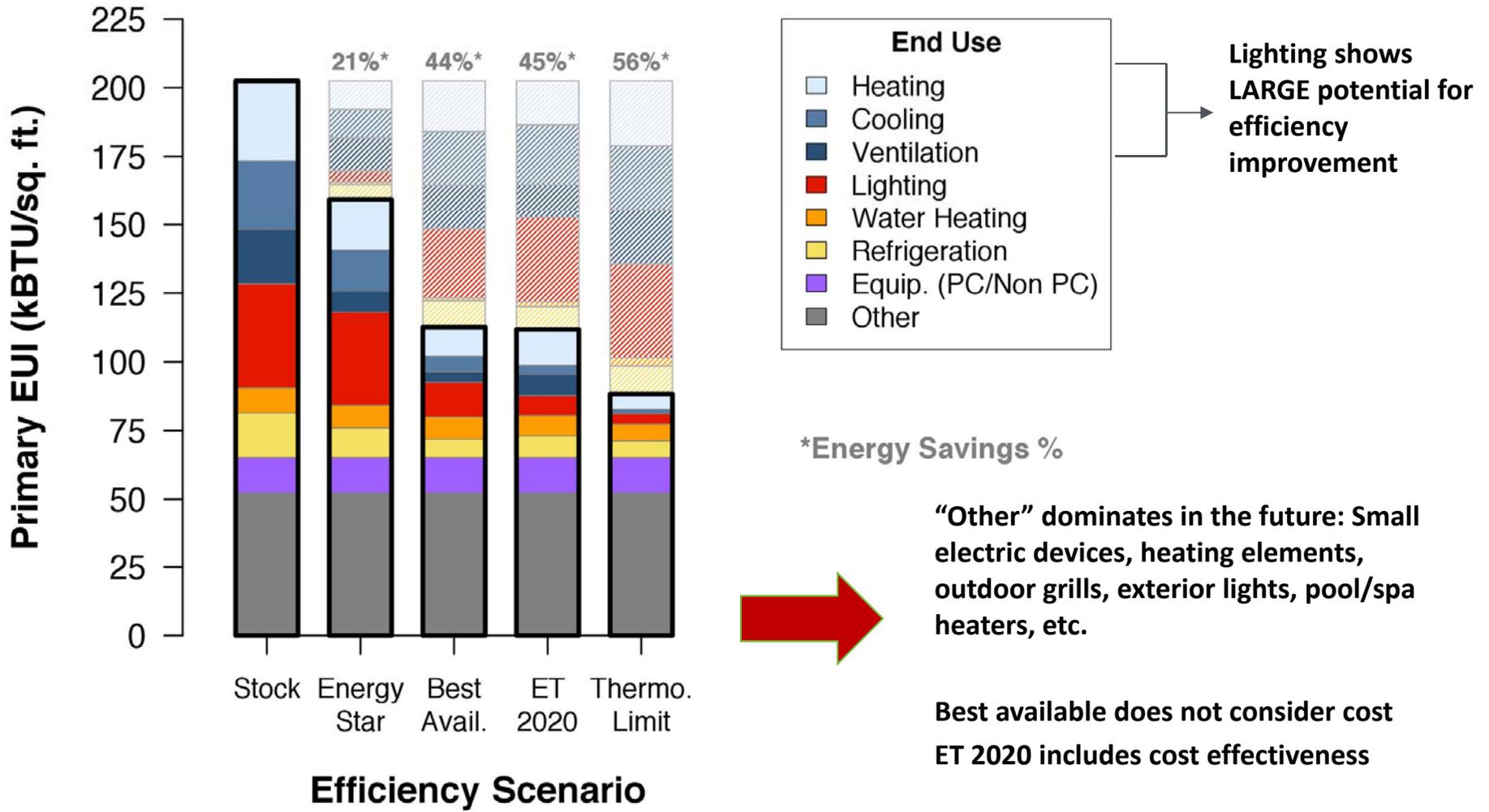
Potential Opportunities of Residential Building Energy Efficiency

Residential Energy (Single Family, All Regions)

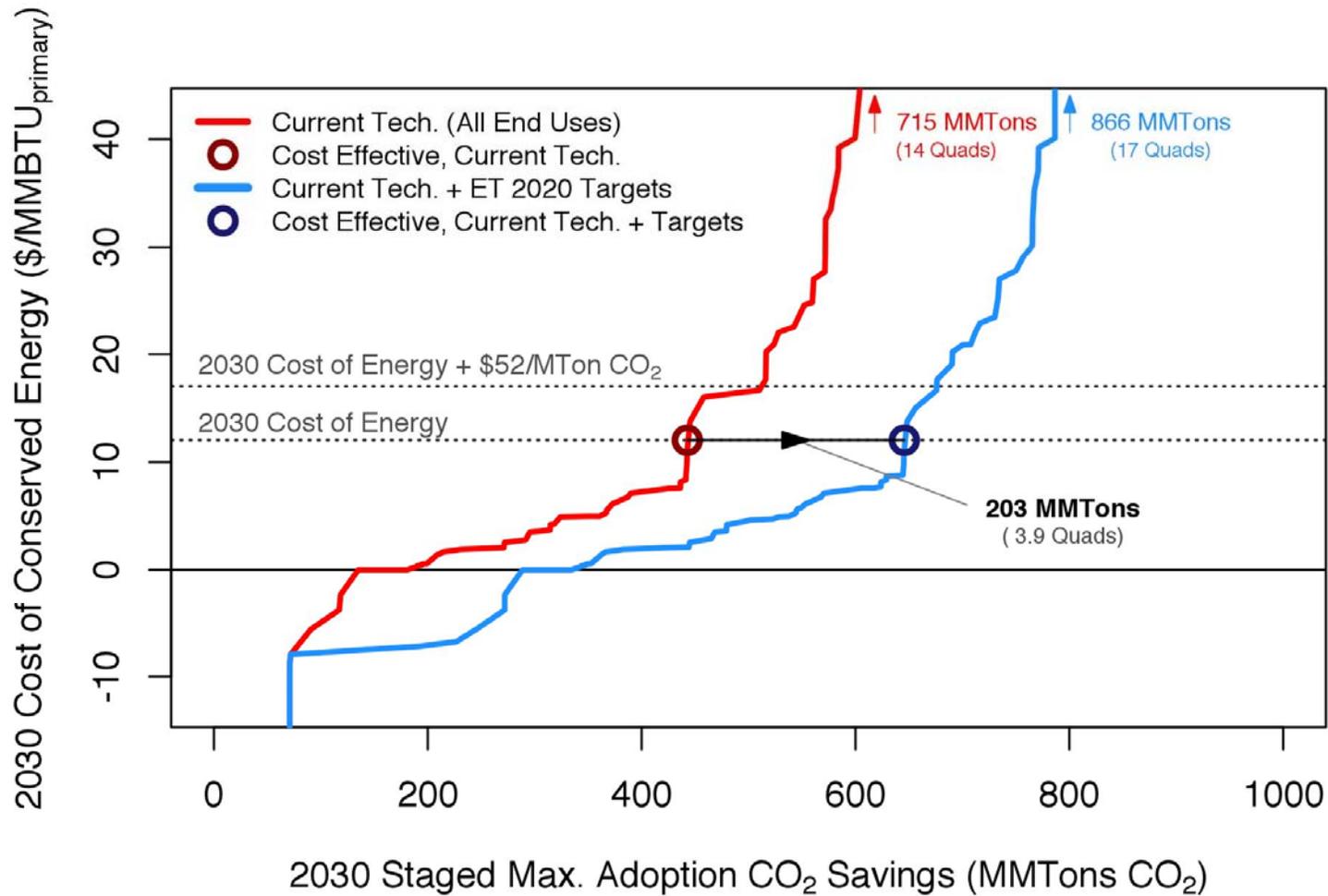


Potential Opportunities of Commercial Building Energy Efficiency

Commercial Energy (Composite, All Regions)

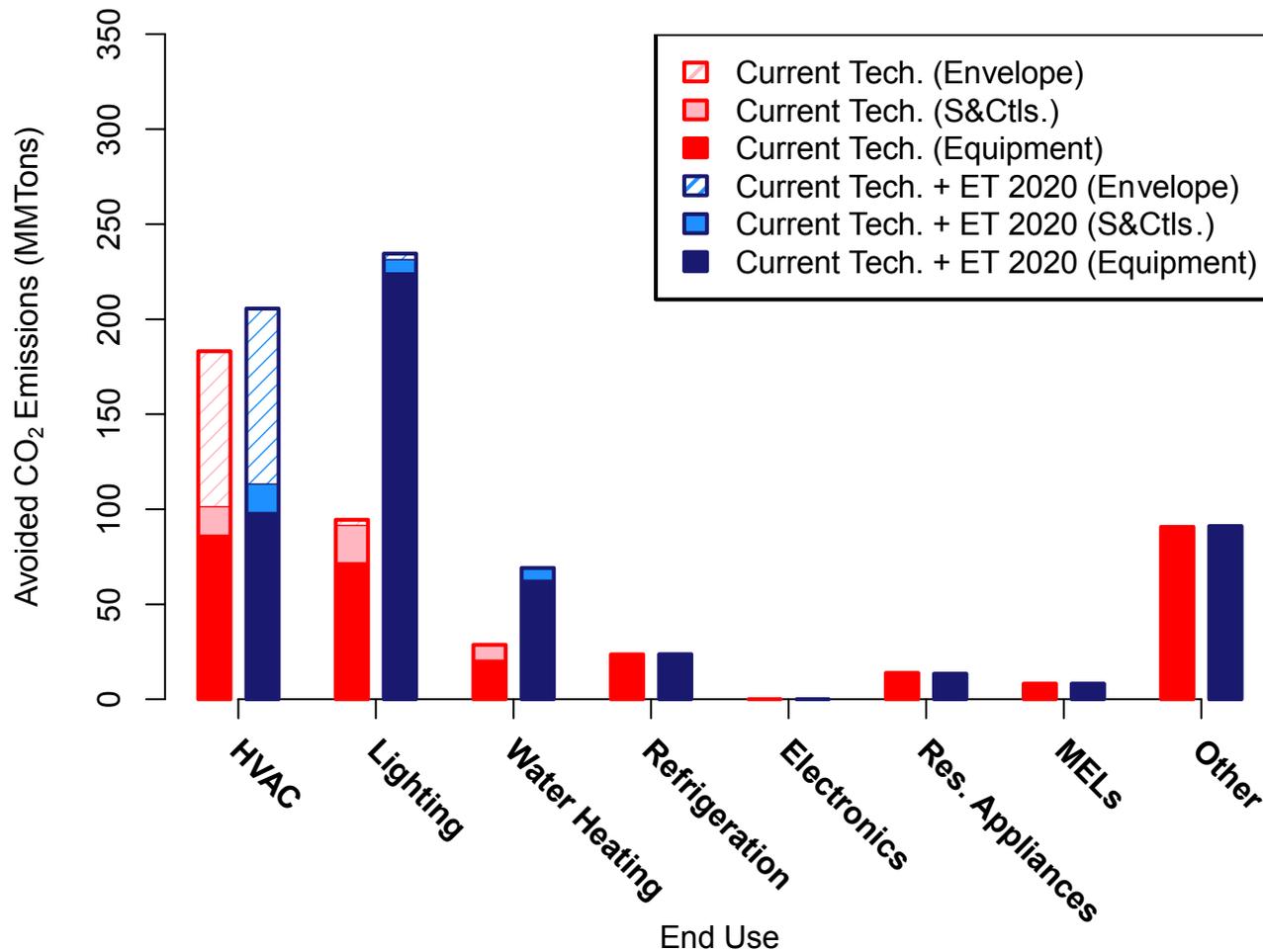


2030 Cost Effective Avoided CO₂ Emissions (All Buildings Sectors)



2030 Cost Effective Avoided CO₂ Emissions by End Use (All Bldgs.)

HVAC & lighting yield largest cost effective avoided emissions



Commercial Buildings Integration (CBI) Program

Our Process:

1. Develop and demonstrate **technologies, tools, and solutions** to remove barriers to investment and increase understanding of efficiency measures
2. Demonstrate and deploy actionable products through **market partnerships** to drive efficient technologies into the commercial buildings marketplace



How We Stimulate Technology Adoption in the Market

High Impact Technology (HIT) Catalyst Program:

Identify and guide technologies through early market introduction phases...

Pre-Adoption	Market Barrier	DOE Activity	Result
	Technology isn't available in market at reasonable price...	Innovation Challenge	... manufacturers are encouraged to develop a viable product that is not currently on the market.
	Uncertain about real world performance...	Tech Demonstration	...a HIT is installed and monitored in a real world setting with energy performance communicated via a case study.
	There are too many questions on how to choose or purchase ...	Support Resources	... assistance on how to select, size, install, and properly operate a HIT to maximize energy performance is provided.
	They are waiting until the broader market adopts...	Tech Adoption Campaign	... end users (such as Better Buildings Alliance members) are encouraged to commit to installing the High Impact Technology.

All Early Adopters

...ultimately leading to broad market adoption.

Rooftop Units – Technology through the CBI Pipeline

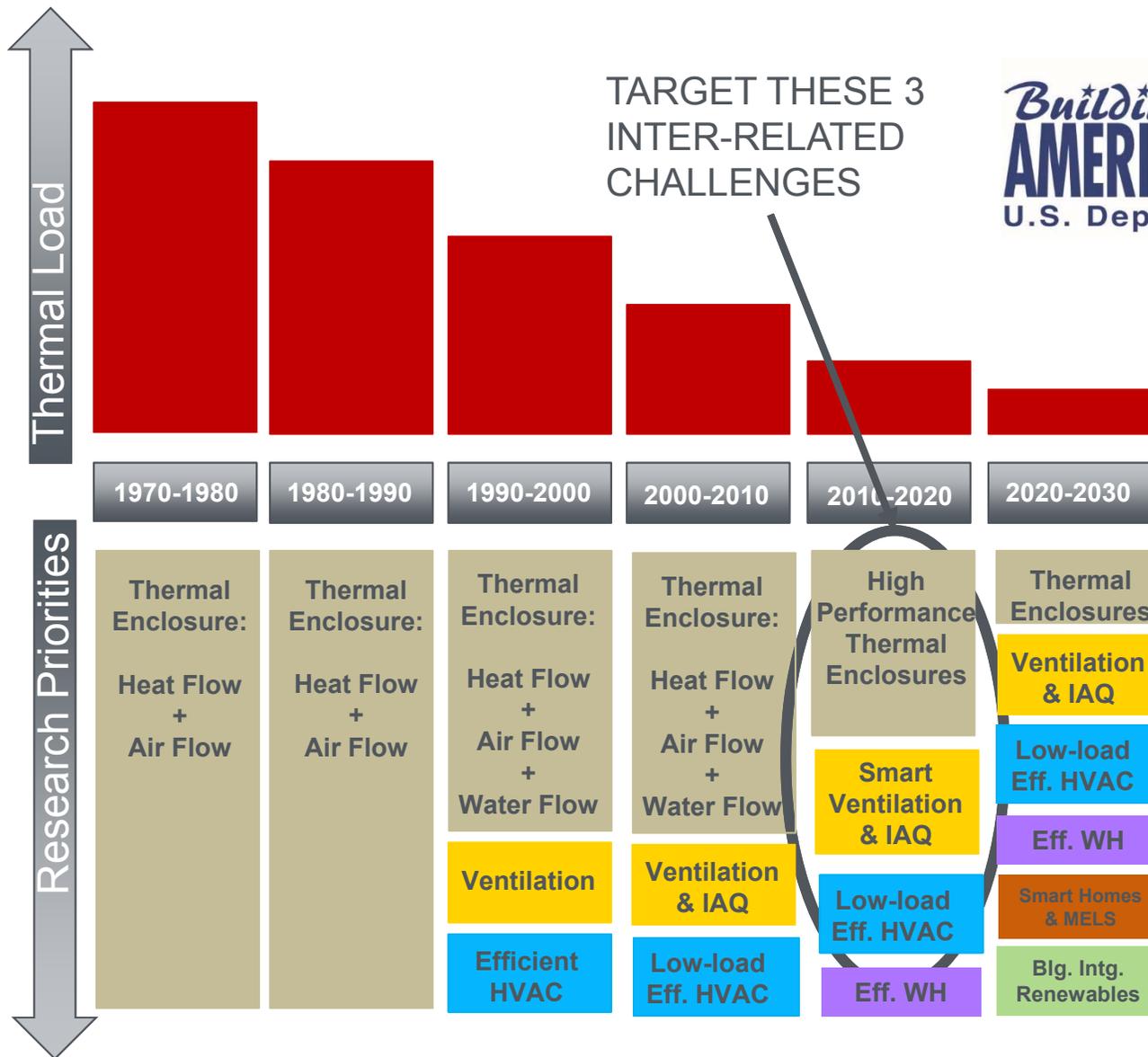


CBI DEPLOYMENT STRATEGY	Direct resource development and demonstration	Market stimulation via leading organizations	Deployment through leaders' portfolios and consideration for voluntary standards	Data feeds into market acceleration and standards
ACTIVITIES	FY12-13: Produced Manufacturer's Challenge SPECIFICATION via ET and BBA.	FY14-15: DEMONSTRATIONS of winning units with building owners and federal partners.	FY14-16: Drive market uptake of RTU efficiency strategies and track impact through the Advanced RTU Campaign for adoption of CEE Tier 2 RTUs	FY15-16: continue to campaign for Tier 2 replacements which support the adoption of a higher Tier 3 which matches Challenge Unit efficiency and drives overall efficiency higher.
IMPACTS	By end of FY13, 2 manufacturers had met the RTU Challenge. By FY14, 5 different manufacturers had produced units meeting the combined efficiency requirements of the specification (IEER = 18).	Measurement from demos prove average savings and reduce risk for owners; case studies help make the business case.	Campaign quantifies actual energy savings, market uptake trajectory, and adoption by market leaders. If 100% of RTUs were replaced based on Advanced RTU Campaign targets, we would save 0.4-1 Quad of primary energy.	Advanced RTU Campaign impact: 26,000 RTUs have been upgraded with high efficiency Tier 2 replacement units (minimum 20% savings) or retrofitted with advanced system controls (average 50% savings).

Residential Buildings Integration (RBI) Program



Building America Technology Roadmap



Zero Energy Ready Homes are Expanding in Market





ZERO
ENERGY READY HOME
U.S. DEPARTMENT OF ENERGY

A Symbol of Excellence

HEALTHFUL ENVIRONMENT

COMFORT PLUS

ADVANCED TECHNOLOGY

ULTRA EFFICIENT

QUALITY BUILT

DURABILITY

KEY

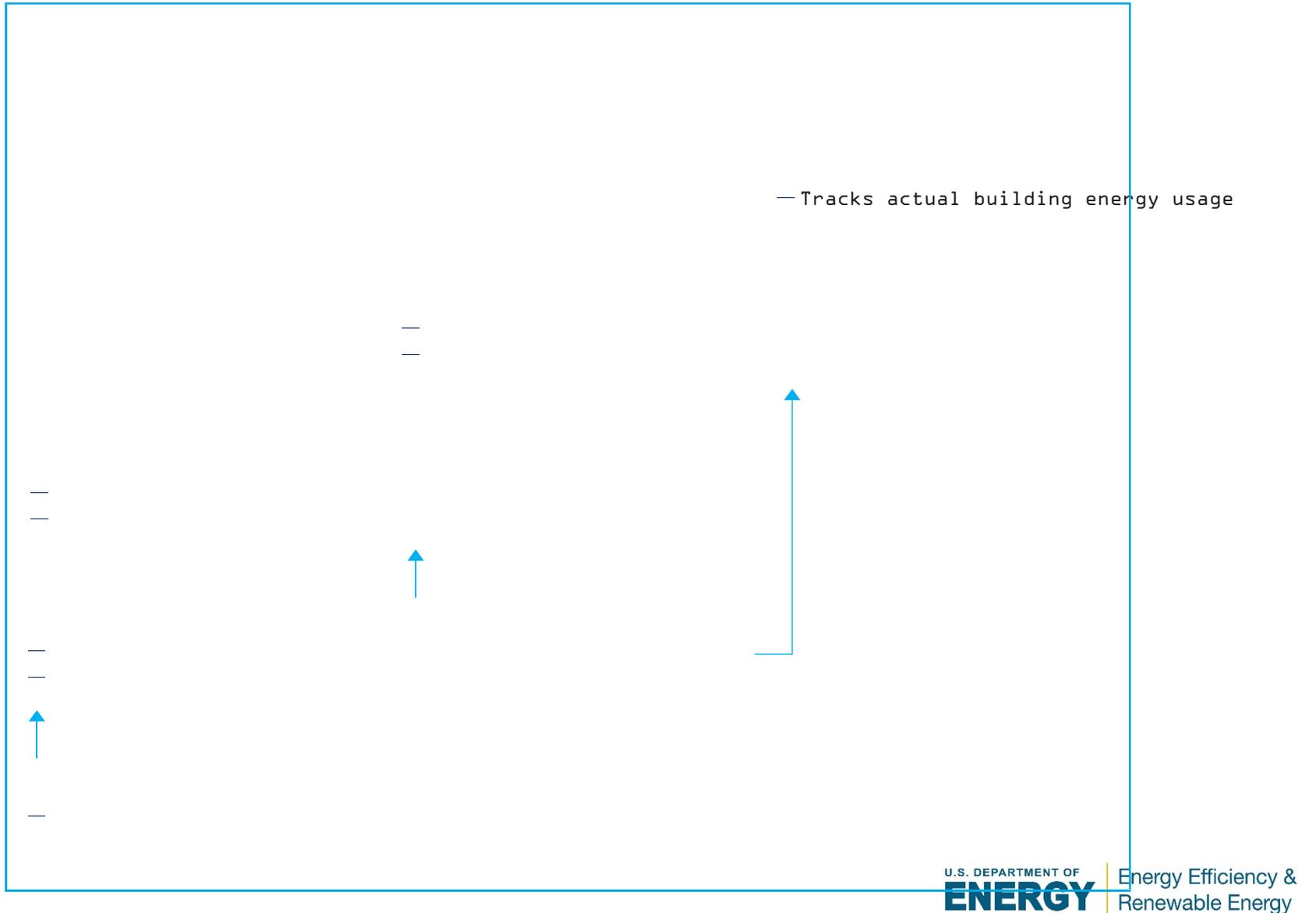
- DOE Zero Energy Ready Home
- ENERGY STAR Home
- Existing Home

This label indicates relative performance of this DOE Challenge Home to existing homes (built between 1990 and 2010) and ENERGY STAR qualified homes. Actual performance may vary.



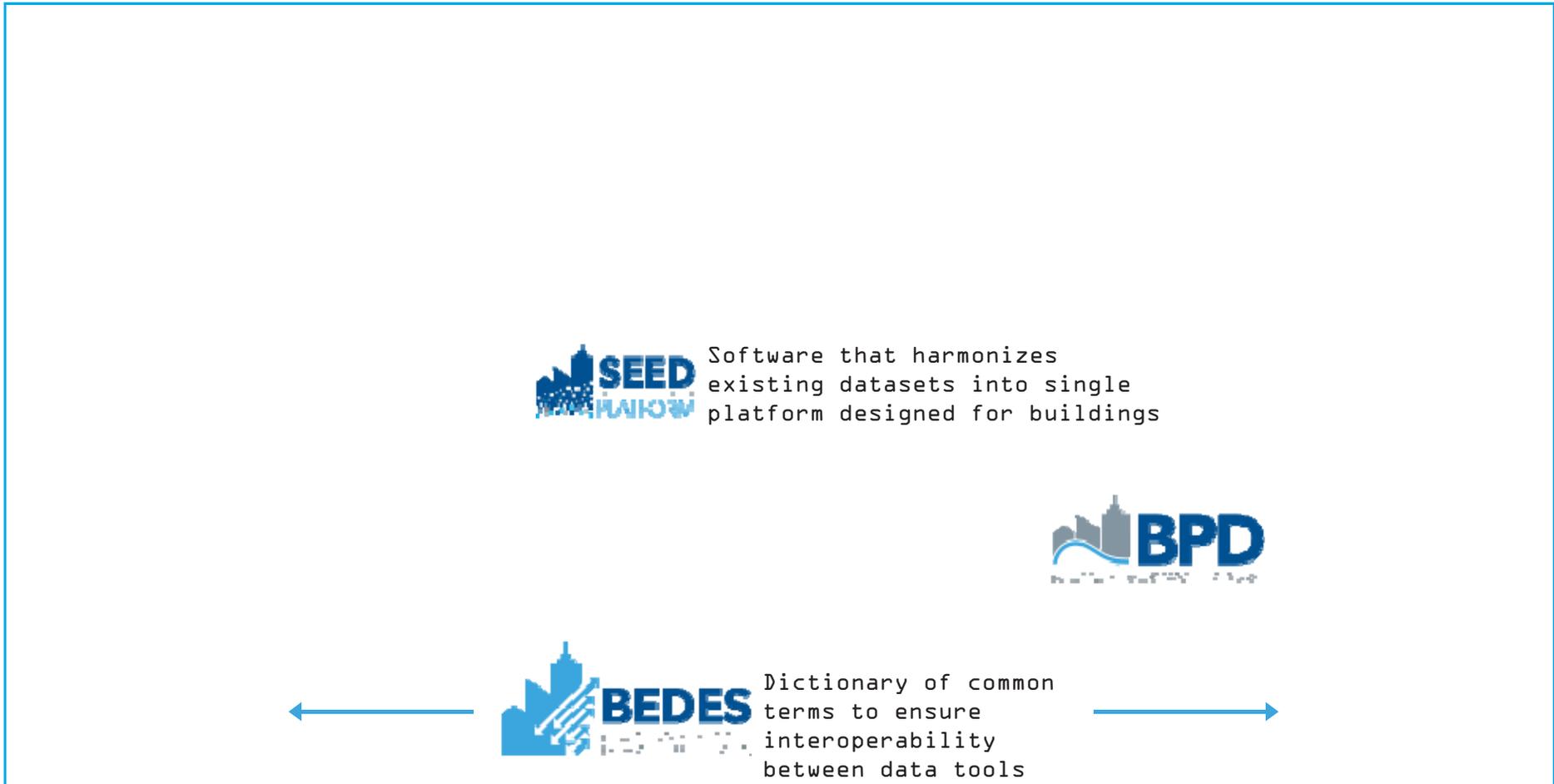
DOE Design and Operation Tools

Goal: Integrate energy-related information throughout building lifecycle



Data Analysis & Management Tools

Goal: Increase availability and consistency of energy-related information

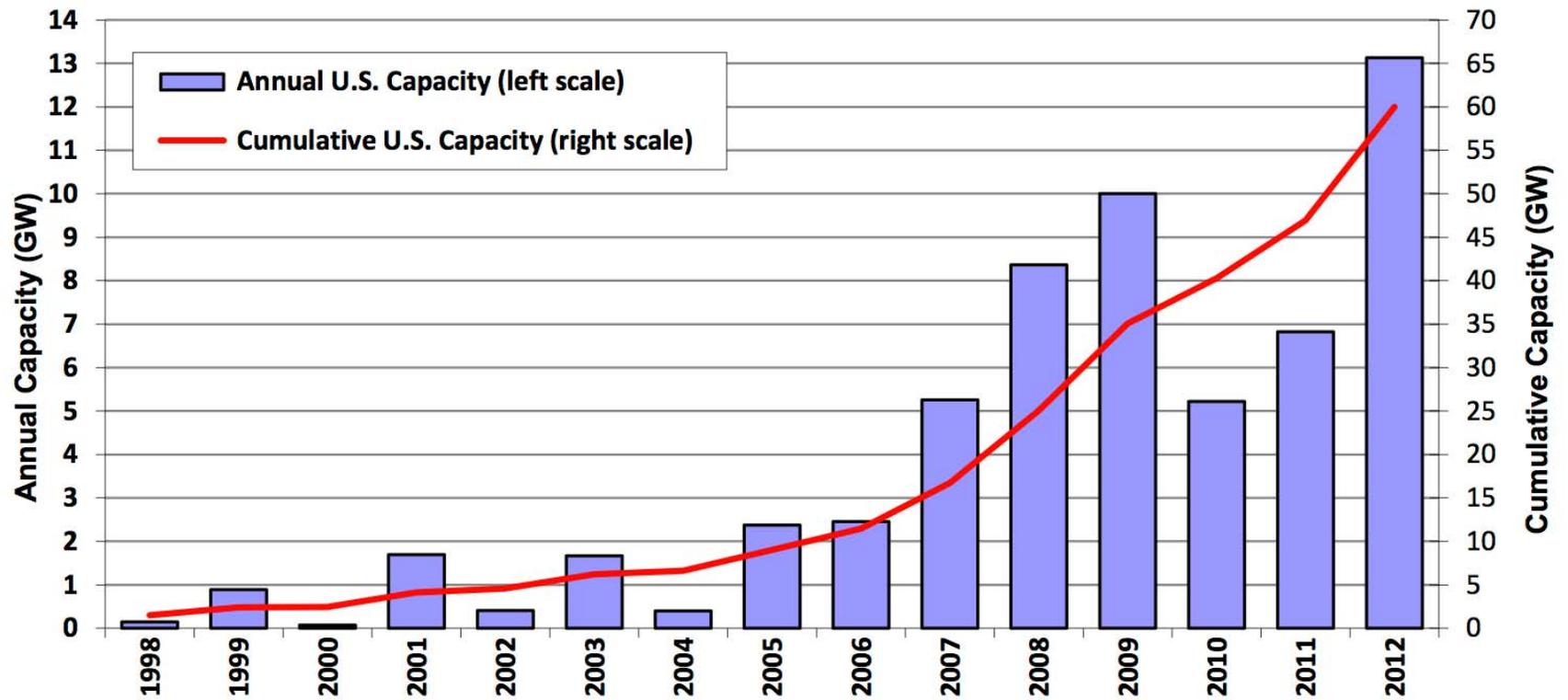


DOE's High Level Grid Integration Goals

- Enable high penetration of clean energy and energy efficient technologies on distribution systems while maintaining reliability, safety, and affordability;
- Enable various clean energy and energy efficient technologies to interact with one another and the grid to optimize solutions across multiple objectives; and
- Leverage Recovery Act grid modernization investments and increase the value proposition of clean energy technologies.

EERE Grid Modernization Initiative

Seamlessly integrating emerging technologies into the grid in a safe, reliable, and cost-effective manner is critical to enabling deployment at scale.



Source: AWEA project database

Figure 1. Annual and Cumulative Growth in U.S. Wind Power Capacity

Buildings to Grid Vision

Buildings will be self-configuring, self-commissioning and self-learning such that they optimize operation, maximize energy savings cost effectively and can participate in transactions within the building, between buildings and with the grid



Interoperability is a solution—and the largest unresolved issue

Challenges

- Lots of information
↓
- But it is trapped or hard to use
↓
- Stranded assets

Opportunities

Interoperability provides lower cost, scaled solutions for:

- Equipment manufacturers
- End users
- Service providers
- Utilities

BTO Role in Integrating Buildings with the Grid

Work with the market to:

1. Develop and commercialize advanced sensors and controls

2. Define, test, quantify, and validate the value proposition, characteristics/capabilities, and related services

3. Enable buildings to participate in transactions within the building, between buildings, and with the grid

Pathway to Commercialization of Low-cost Wireless Sensors

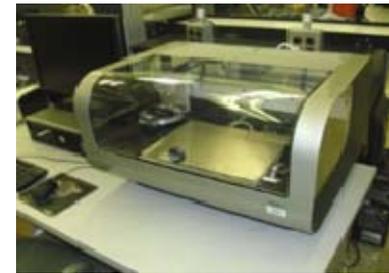
Project Goal:

Develop and deploy low-cost wireless sensors for building monitoring to realize energy savings through optimal control of building subsystems.

- Reduce cost to manufacture and commission (\$1-\$10/node)
- Low-power wireless communication driven by energy harvesting techniques
- Retrofit-friendly devices with minimal maintenance
- Multi-sensor platform tailored for building monitoring needs
- Leverage additive, roll-to-roll manufacturing techniques to enable rapid adoption

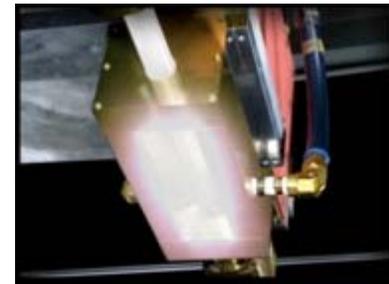
Recent Accomplishments:

Cooperative Research and Development Agreement (CRADA) recently established with commercial manufacturer, Molex to reduce cost through manufacturing improvements.



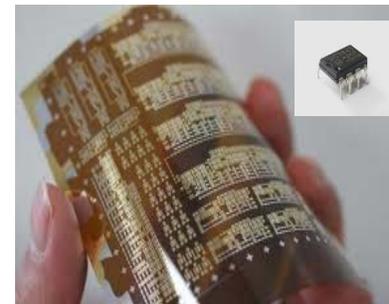
Print components on flexible substrates:

- Circuits
- Sensors
- Antenna
- Photovoltaics
- Battery



Low temperature photonic curing:

- Sinters ink for high electric conductivity
- Plastic substrate undamaged



Peel and stick flexible platform:

- Pick and place unprintable components

BTO Role in Defining Connected Equipment

Develop a characterization protocol structure and performance metrics that will:

- **Promote innovation** among the industry players.
- **Help establish a scalable market** for connected equipment through developing data and information to inform consumers/building owners, manufacturers, and electric and gas utilities.
- **Protect consumer value** through quality of service and amenities provided by the equipment and minimize cost of life-cycle operation.
- **Protect manufacturers** by avoiding damage to equipment, violation of warranty, and consumer dissatisfaction.
- **Inform utilities and service providers** of the end-user, societal, grid, and energy market services that the connected equipment can deliver, as well as create an opportunity for new services and value streams for the different stakeholders in the future.

Look for “**A Framework for Characterizing Connected Equipment**” at:
<http://energy.gov/eere/buildings/buildings-grid-publications>

Appliance Standards Lock in Energy Savings

Climate Action Plan Goal:

Reduce CO₂ emissions by 3 billion metric tons by 2030 through standards set from 2009-2016

Projected Savings from Standards since 2009:

- **39.3 quads** of energy savings by 2030
- **\$522 billion** of energy bill savings by 2030
- **2.2 billion metric tons** of reduced CO₂ emissions by 2030

Consumer



Commercial and Industrial



Lighting



Plumbing



Building Energy Codes Lock in Energy Savings

Codes since 2010:

- **30%** improvement in model energy codes for residential and commercial buildings (2 - three year cycles).
- **42 states** have updated energy codes

Projected Cumulative Savings (2010-2030):

- **14 quads** of energy savings
- **\$125 billion** of energy bill savings
- **1 billion metric tons** of reduced CO₂

