

U.S. DEPARTMENT OF  
**ENERGY**

Office of  
**ENERGY EFFICIENCY &  
RENEWABLE ENERGY**

# DOE Building Technologies Office Overview

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September 2019



# Our Homes and Buildings



There are **123 million buildings** in America.



More than 80% of them are **20 years old or older**.

They use **40%** of America's **energy** and **75%** of its electricity.

At least **20%** of this **energy** is **wasted away** in buildings.

Our Homes and Buildings Use More Energy than Any Other Sector



Buildings' **energy bill** is **~\$415 billion annually**, much of which is wasted

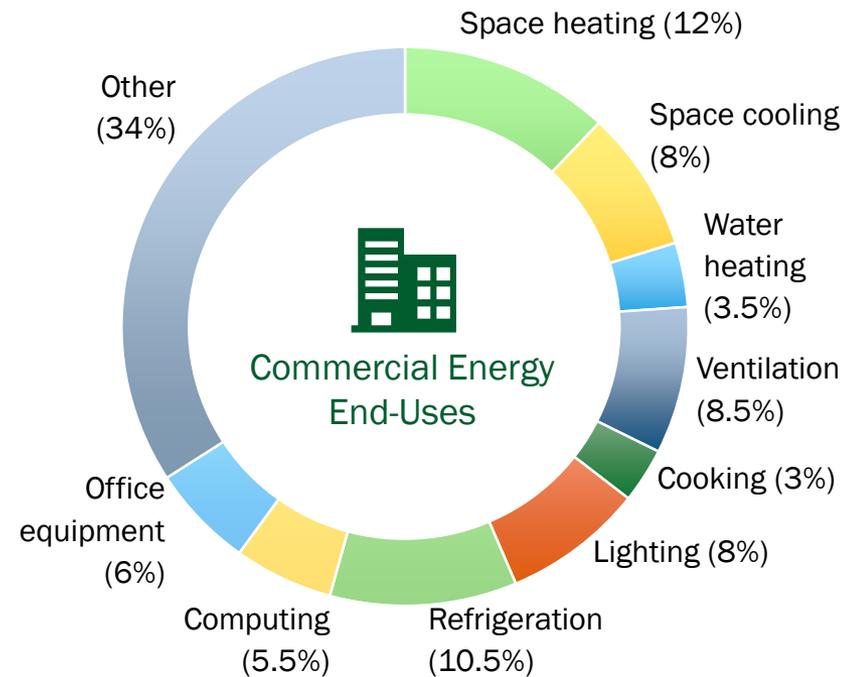
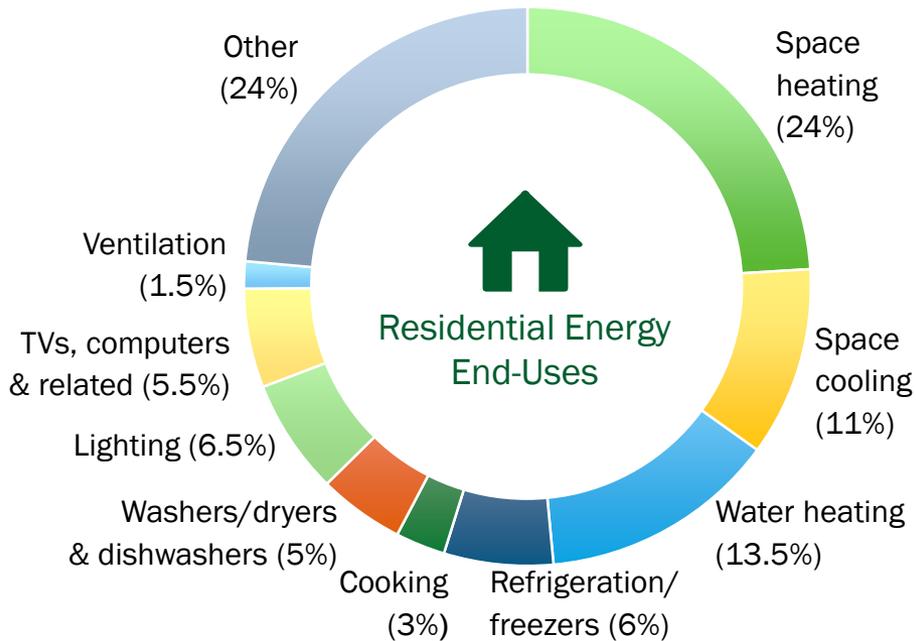


Buildings consume **up to 80% of peak electricity**, often the dirtiest and most expensive electricity utilities can make

Source: EIA Monthly Energy Review;; U.S. Energy Information Administration (CBCECS 2012/RECS 2015); NAREIT Reits by the Numbers; Census Bureau Quarterly Retail E-Commerce Sales 4<sup>th</sup> Quarter 2016

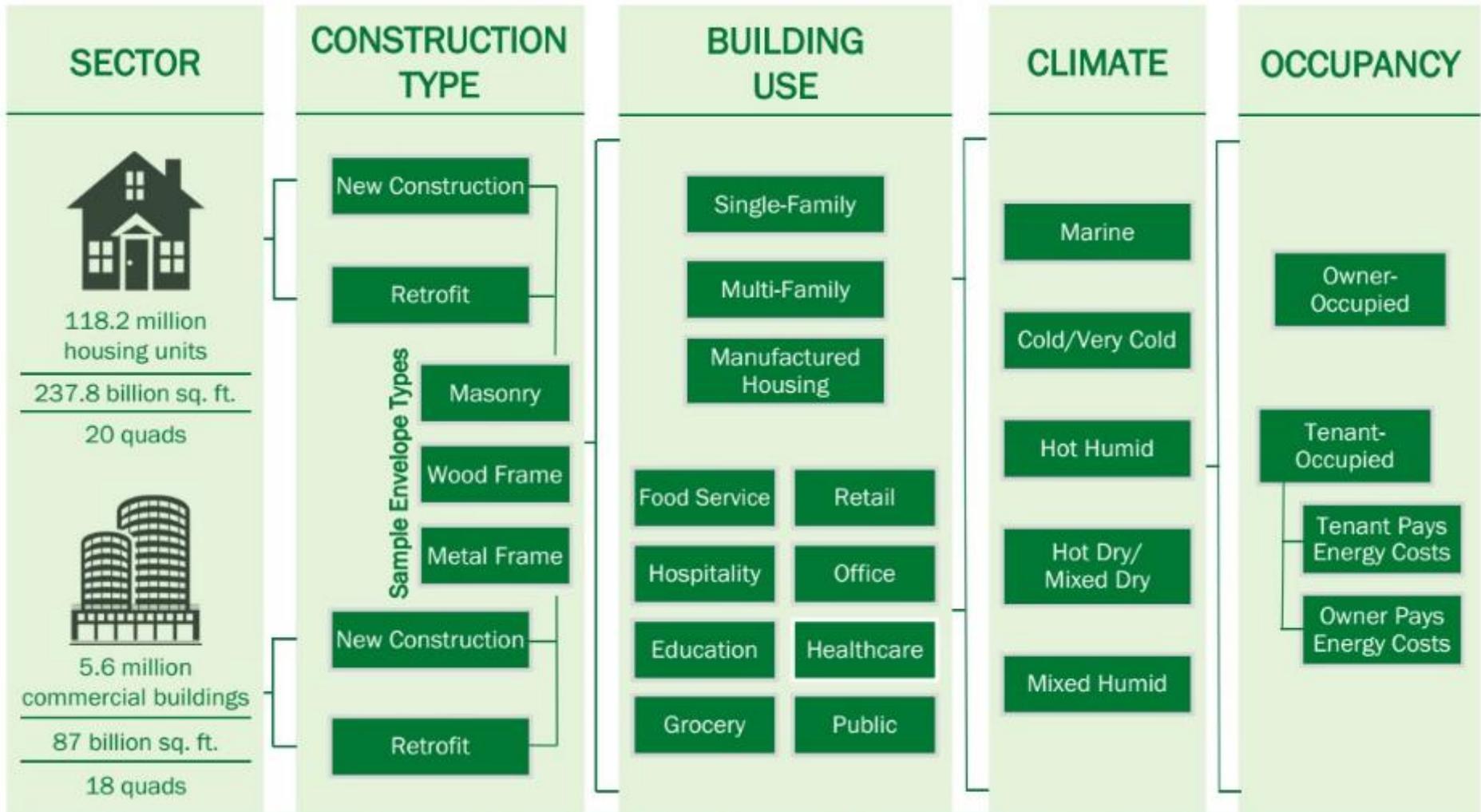
# Our Homes and Buildings

We consume energy in our homes and buildings in many ways, ranging from appliances, lighting, and mechanical equipment to personal electronics.



Source: U.S. Energy Information Administration AEO 2018

# Complexity of Energy Use in the Buildings Market



## Sample Technology Areas (Gas and Electric)



# Market Barriers for Building Energy Efficiency

**Diversity of Businesses** serving the buildings sector, making scale difficult

**Lack of Reliable Information** on the energy use and efficiency of specific end uses

**Performance Uncertainties** and the perceived risk of making significant investments in energy efficiency

**Lack of Mechanisms** for establishing the market value of more energy-efficient properties

**Split Incentives** between owners and occupants of rental properties in both the residential and commercial sectors.



Photo Credit: Clean Energy Resource Team; dalioPhoto, Flickr Creative Commons

# BTO's Approach - Five Programs



## **R&D (Building Energy Research & Development Program)**

Pre-competitive, early-stage investment in next-gen technology



## **Integration (Commercial and Residential Programs)**

Technology validation, field & lab testing, decision tools, market integration



## **Codes & Standards Program**

Codes & standards development and technical analysis, standards promulgation



We lead R&D on technologies that make our homes and buildings more affordable and comfortable, and make America more sustainable, secure, and prosperous.

Our investments strengthen America's \$68 billion building energy efficiency marketplace.

Without a catalyst like BTO, the housing industry would take 10 to 25 years to adopt new technologies and techniques.

Source: AEE Advanced Energy Now 2017 Market Report, Wolfe, Raymond M. (2016). Business Research and Development and Innovation: 2013 Detailed Statistical Tables.

# DOE Research Has Saved Energy

## Past



- \$1,200 purchase
- \$200/year to operate
- 18 cubic feet



- \$8/year
- 60 Watts
- 1,000 hour life



- Single-pane
- High heat loss

## Present



- \$550 purchase
- \$50/year to operate
- 22 cubic feet



- \$2/year
- 15 Watts (or less)
- Up to 25,000 hours



- Double-pane & low-e
- Low heat loss
- 3x more efficient

## Future



Due to appliance standards alone, a typical household saves about **\$320** per year off their energy bills today, and as people replace their appliances with newer models, they can expect to save about **\$530 annually** by 2030.

# Commercial Buildings Integration

**Goal** By 2025, market leaders will achieve in their buildings an improvement in energy consumption per square foot of at least **35%** relative to typical commercial buildings in 2010.

## Strategy

- Conduct whole-building and **systems integration R&D**
- **Validate energy performance** of targeted, high-impact technologies (HITs)
- Develop **modeling and analysis tools** that provide opportunities for identifying pathways for energy performance
- Support research needed for **zero energy buildings**

**Sub-Programs** Wireless Metering Challenge, Analysis Tools, Design & Decision Support Guides, Workforce Development & Training, Zero Energy Buildings

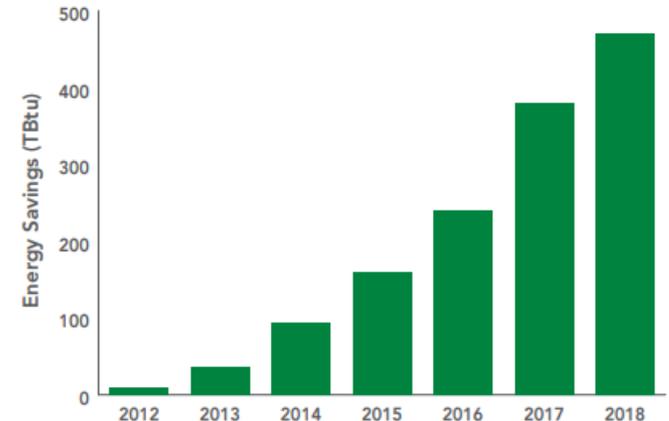


# Better Buildings Initiative

The goal of Better Buildings is to dramatically improve the energy efficiency in the commercial, public, industrial and residential sectors by at least 20% over the next decade.

- There are more than **900 organizations** that make up the Better Buildings Initiative, including **17 Federal Agencies** and **8 National Laboratories**
- Key Program Results:
  - Partners 900+
  - Square Feet 12.5 billion;
  - Industrial Facilities 3,200;
  - Energy Saved (QBtu) 1.38;
  - Dollars Saved \$8.4 billion
- More than 360 partners have joined the Better Buildings Challenge. Reported 470 trillion Btus in energy savings and \$3.8 billion in cost savings.

Better Buildings Challenge  
Cumulative Energy Savings



Partner Growth by Year



# Grid-interactive Efficient Buildings (GEB)

*A new, holistic approach that reaches beyond a building's walls and into the grid to maximize the energy efficiency and buildings and the grid simultaneously*



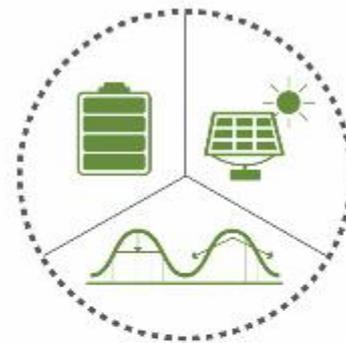
## EFFICIENT

Persistent low energy use minimizes demand on grid resources and infrastructure



## CONNECTED

Two-way communication with flexible technologies, the grid, and occupants



## FLEXIBLE

Flexible loads and distributed generation/storage can be used to reduce, shift, or modulate grid-level energy use



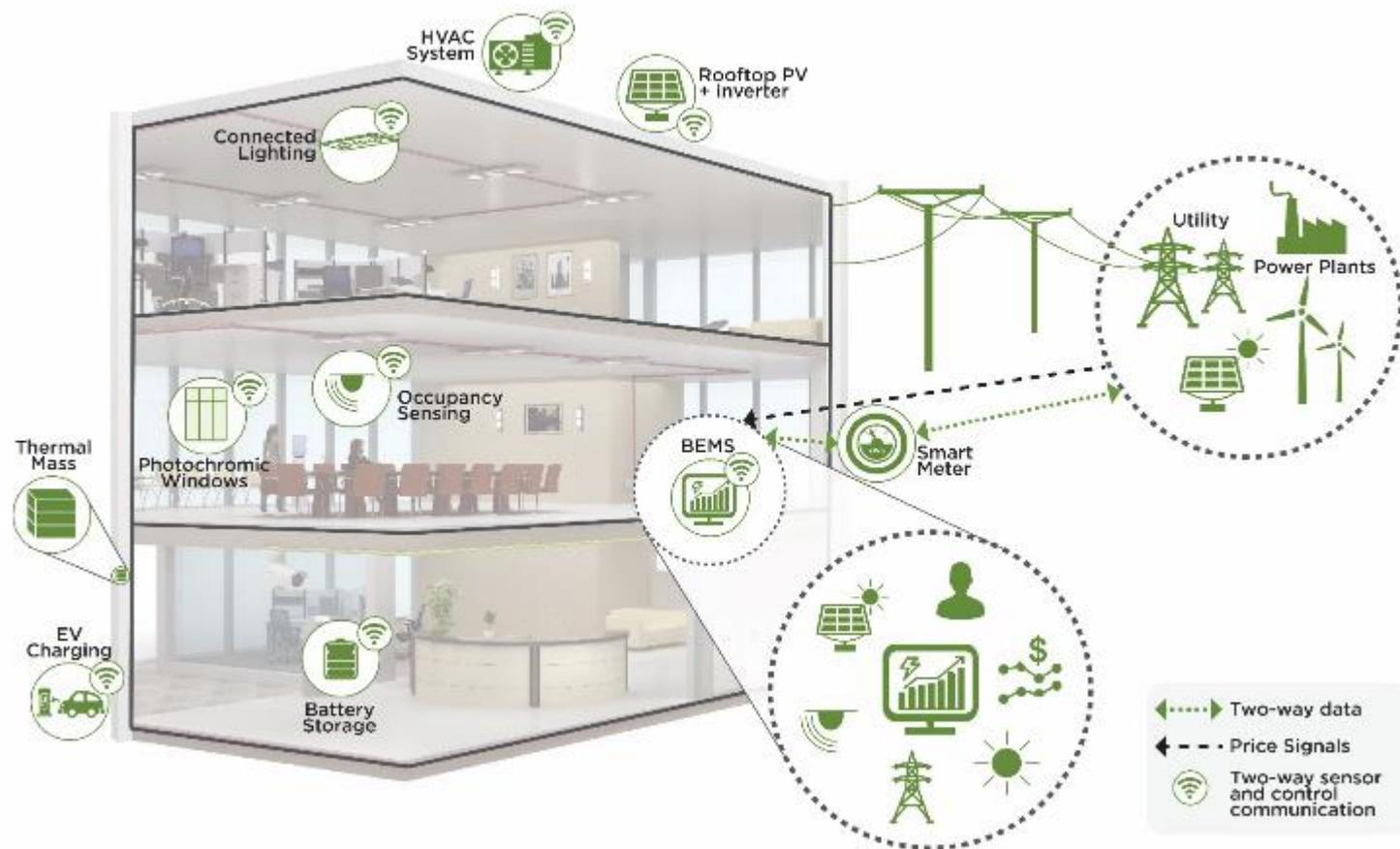
## SMART

Sensing, control, and analytics co-optimize efficiency, flexibility, and occupant needs

[www.energy.gov/eere/buildings/geb](http://www.energy.gov/eere/buildings/geb)

# A Grid-interactive and Efficient Office

## Grid-Interactive Efficient Commercial Buildings



# Advanced Building Construction

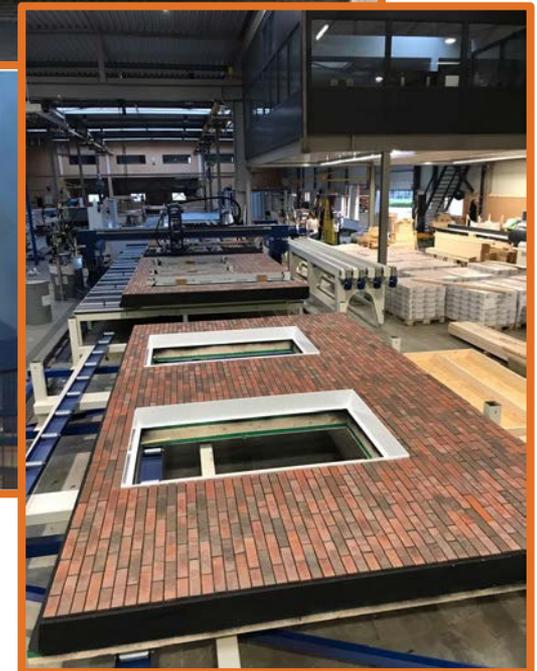
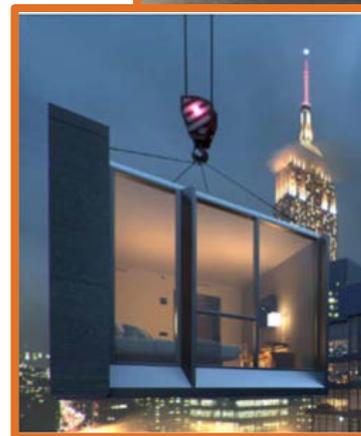
*Next-gen technologies and practices that improve building energy performance without increasing costs of building construction, including innovations in design, component fabrication, onsite assembly, and construction process integration*

- ✓ **New Construction & Retrofit applications**
- ✓ **Residential & Commercial**
- ✓ **Lean Construction & Remodeling processes:**
  - Shorter construction schedules
  - Less production uncertainty
  - Construction cost savings through component standardization & automation
  - Improved labor productivity
  - Fewer installation errors
- ✓ **Off-site production technologies**

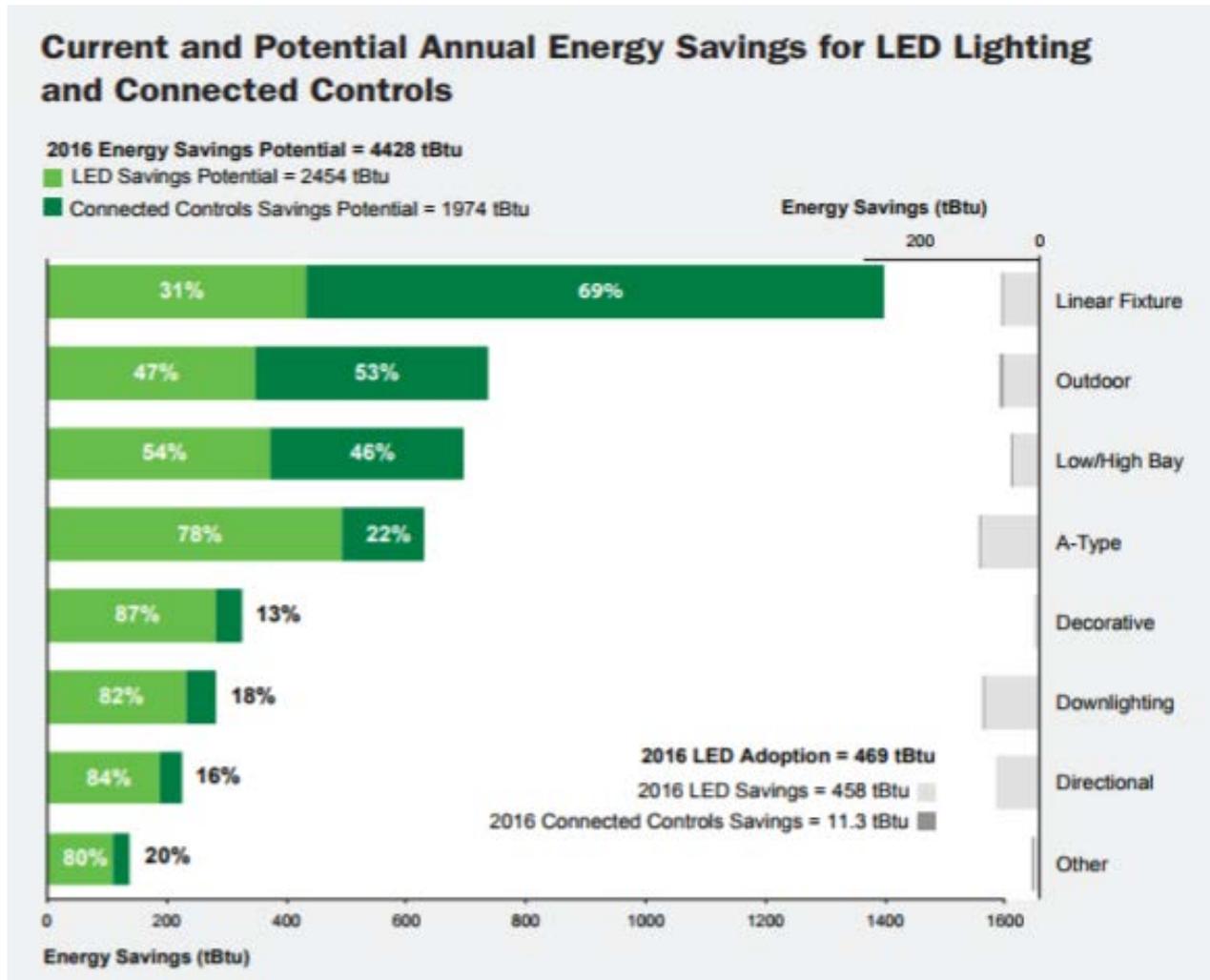


# ABC Initiative @ BTO

- An integrated strategy across BTO
- Early-stage R&D focused on whole building savings, with requisite advancements in building envelope, HVAC, DHW
- Seeks transformative technology packages, not incremental improvements; and reduce risk and accelerate tech to market
- Seeks regional/local solutions that account for differences in building stock, workforce, and other factors
- “Not a project, but an approach”



# LEDs Make Progress, Great Opportunity Remains



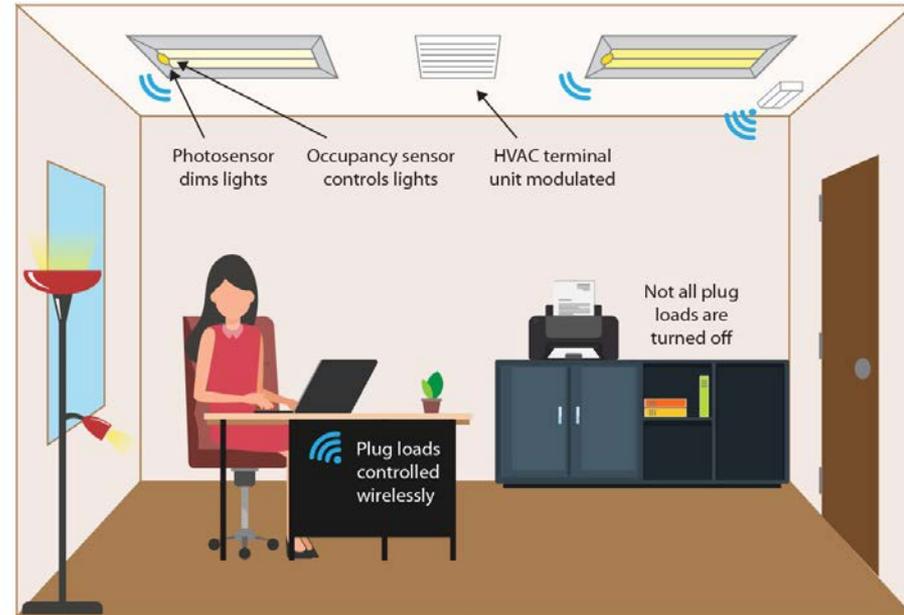
In 2016, LED products delivered 469 trillion Btus in source energy savings, or about **\$4.7 billion** in reduced energy bills. Realizing the benefit of connected lighting controls will drive further savings.

Source: Adoption of Light-Emitting Diodes in Common Lighting Applications 2017  
[https://energy.gov/sites/prod/files/2017/08/f35/led-adoption-jul2017\\_0.pdf](https://energy.gov/sites/prod/files/2017/08/f35/led-adoption-jul2017_0.pdf)

# High Impact Technologies – Commercial Building Integration

## Integrated Controls Package for High Performance Interior Retrofit

- Improve total building energy savings from 5-10% for lighting to 25-40%
- In line with DOE Beyond Widgets initiative: this program concept is a significant step toward moving to more holistic program offerings
  - program concept will be fully developed and tested with this pilot
- Nationwide impact could be roughly 760 TBtu energy savings
- Numerous non-energy benefits
  - Occupant satisfaction with retrofits
  - Indoor environmental quality, health
  - Better space utilization



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***QUESTIONS? COMMENTS? LET'S WORK TOGETHER!***

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