Building Envelope R&D Overview

BTO Peer Review 2017

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

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2014 Building Energy Use in U.S.

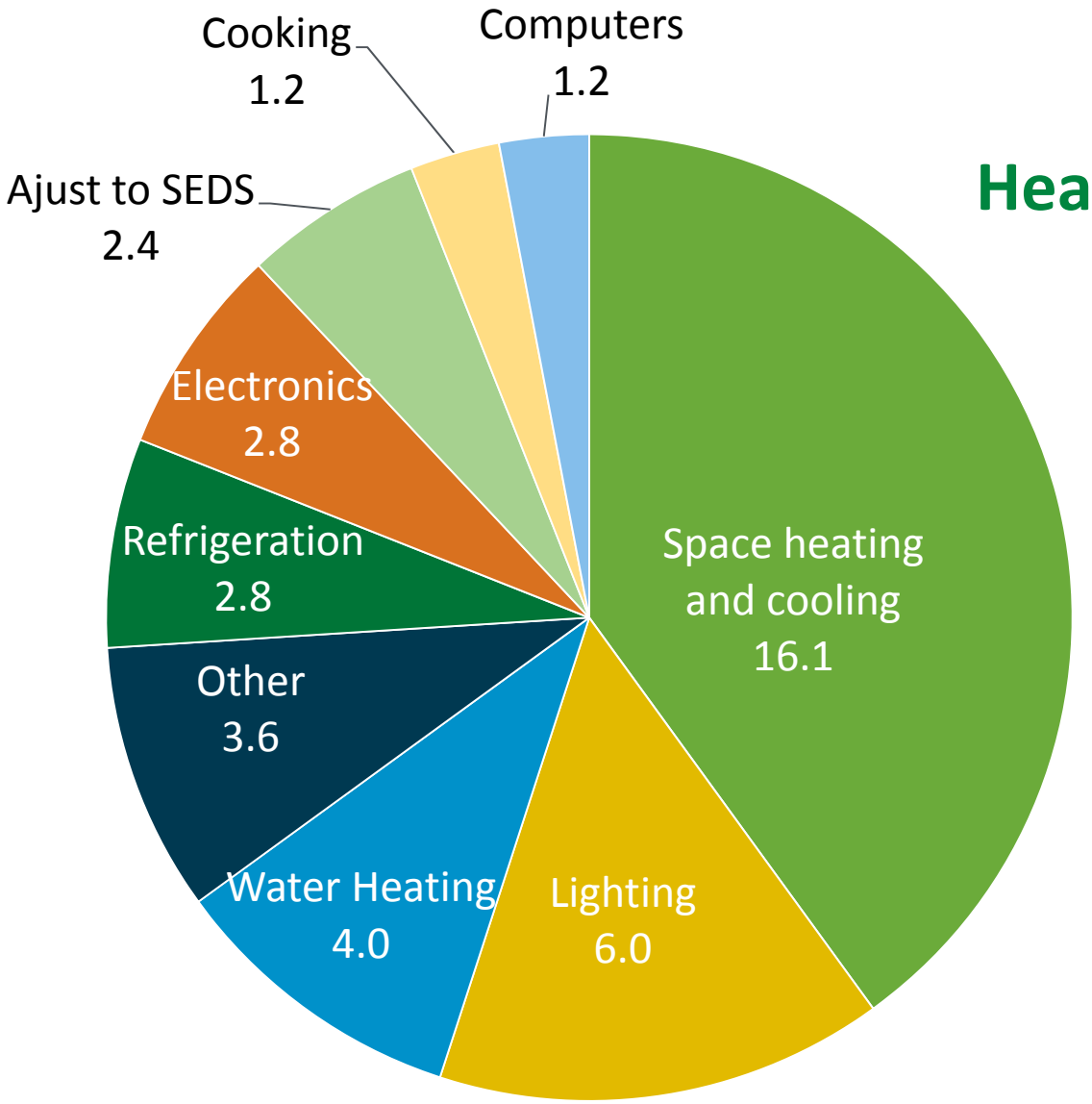
~75% of the electricity

~40% of all primary energy

- Residential, 22%
- Commercial, 18%

In 2050, ~75% of existing building stock will still be in service.

Commercial & Residential Primary Energy End Use (Quads)



Heating & Cooling = 16.1 Quads!

Source: Building Energy Data Book, http://buildingsdatabook.eren.doe.gov/

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Energy Losses in the Building Envelope

Primary energy consumption attributable to fenestration and building envelope components in 2010

Building Component	Residential (quads)		Commercial (quads)	
	Heating	Cooling	Heating	Cooling
Roofs	1.00	0.49	0.88	0.05
Walls	1.54	0.34	1.48	-0.03
Foundation	1.17	-0.22	0.79	-0.21
Infiltration	2.26	0.59	1.29	-0.15
Window (conduction)	2.06	0.03	1.60	-0.30
Window (solar heat gain)	-0.66	1.14	-0.97	1.38

Adapted from the BTO Multi-Year Program Plan: https://energy.gov/eere/buildings/downloads/multi-year-program-plan

Building Envelope R&D

BTO Goal

- By 2030, reduce energy use per square foot of U.S. buildings by 30%, with a longer term goal of achieving 50% reduction, relative to a 2010 baseline.

ET Goal

- Enable the development of cost-effective technologies capable of reducing a building's energy use per square foot by 30% by 2020 and cutting a building's use by 45% by 2030, relative to 2010 high-efficiency technologies.

ET – Research & Development

- Develop technology roadmaps
- Prioritize opportunities
- Solicit and select innovative technology solutions
- Collaborate with researchers
- Solve technical barriers and test innovations to prove effectiveness
- Measure and validate energy savings

Building Envelope Sub-Program Goal

- To accelerate the development of next-generation building envelope technologies that reduce the energy required to heat and cool a building with a specific emphasis on achieving a market-acceptable installed cost to facilitate wide-scale adoption, especially for existing buildings.

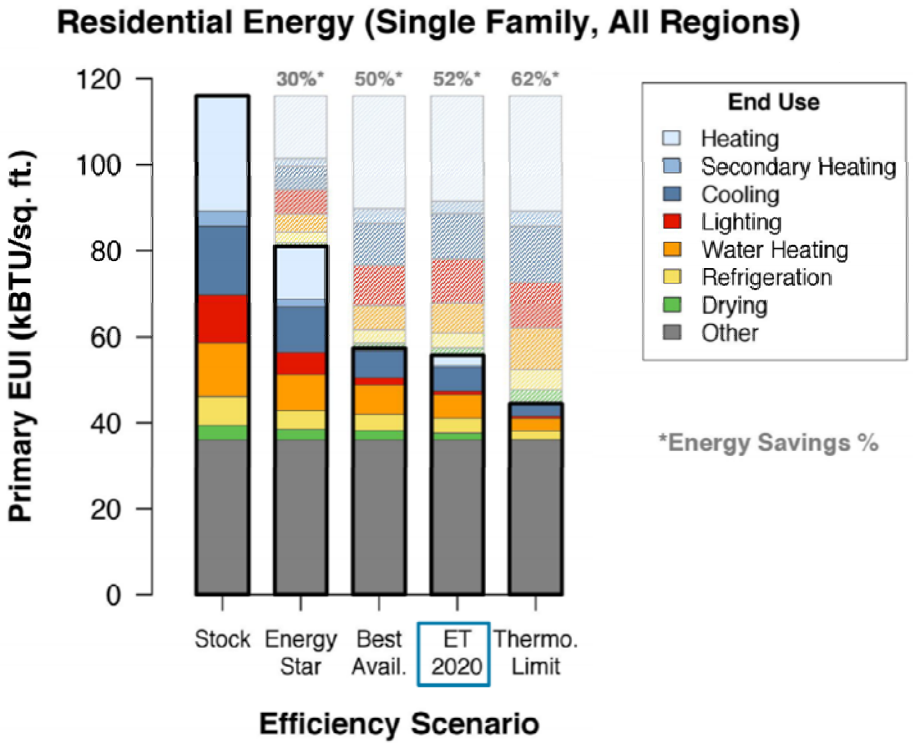
Two R&D Thrusts

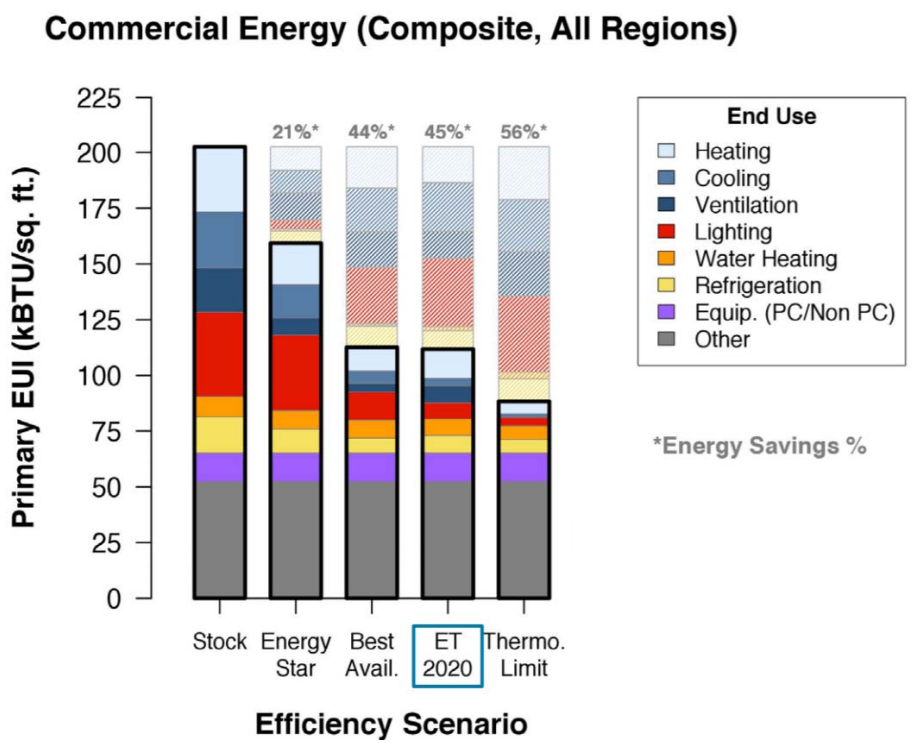
1. New materials and manufacturing processes for thermal insulation that can be applied to walls in existing residential and commercial buildings and roofing technologies for commercial buildings.
2. New air-sealing systems and tools that are capable of preventing uncontrolled heat, moisture, and airflow at reduced installation costs.

Priority areas for envelope R&D based on the roadmap

Technology	2025 Installed Cost Premium Target	2025 Performance Target
Highest Priority R&D Areas		
Building envelope insulation	≤ $0.25/ft^2	• ≥ R-12/inch thermal insulation material for retrofitting walls • Meets durability requirements • Minimizes occupant disturbance
Air-sealing technologies	≤ $0.5/ft^2 finished floor	• Residential < 1 ACH50 • Commercial: < 0.25 CFM75/ft^2 • Concurrently regulates heat, air, and moisture
High Priority R&D Area		
Highly insulating roofs (commercial)	≤ $1/ft^2 over standard roof costs	Energy use reduction equivalent to doubling current ASHRAE R-values

QTR results reflect the potential benefits of envelope R&D

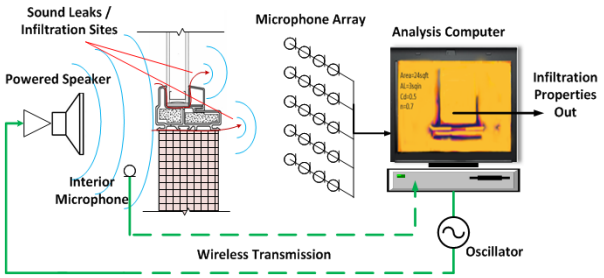


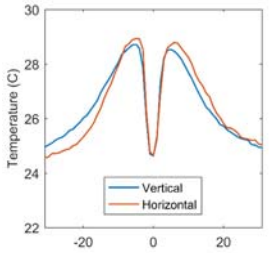


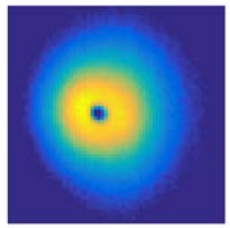
ET 2020 – ET Multi-year Program Plan Targets for 2020

Highlight of Current Building Envelope R&D Projects

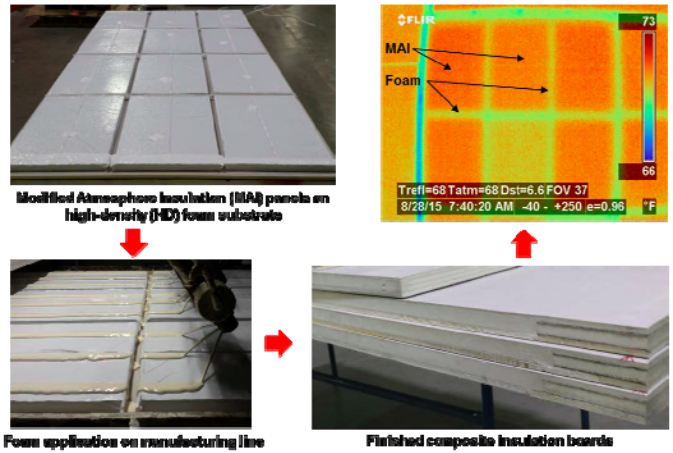
- Performance analysis, evaluation, validation; infiltration diagnostics;

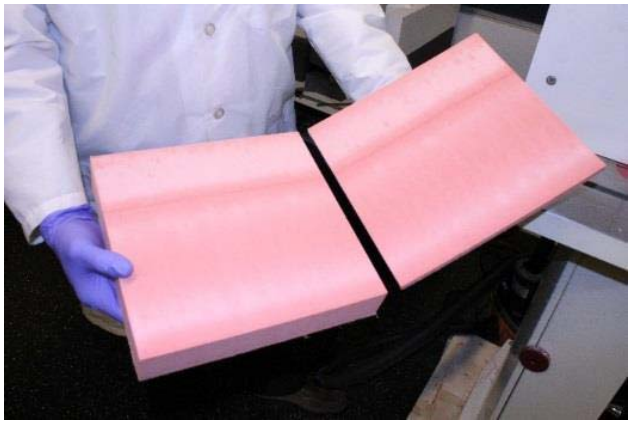


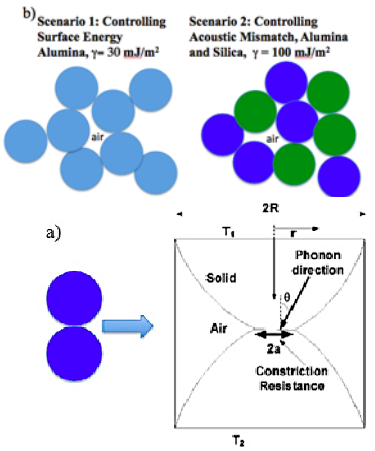




- High R/inch insulation







Areas of interest for envelope

- "Seamless" interfaces/transitions between functional areas (e.g., roof-walls, walls-windows)
  - Air and moisture infiltration, installation cost, construction errors
- Simple, accurate, low cost methods for evaluating envelope air sealing/infiltration
- "Soft" costs as a fraction of total installed costs
- Products and methods that reduce retrofit cost and complexity
  - Air sealing products and methods that remediate flaws and infiltration points
  - Elimination of thermal bridges in the envelope system
- Active/passive thermal and hygrothermal management
- Separations

What Is the Next Step

- Updating Windows and Building Envelope Roadmap
- Holding workshops
  - Next Tent. May 2017
- Think out of the box

Projects to be reviewed today

9:00-9:30 **ORNL** - *Probabilistic Analysis of the Performance of Air Barrier Systems*

9:30-10:00 **ORNL** - *Development and Validation of Fraunhofer Attic Thermal Model (FATM)*

10:00-10:30 **ORNL** - *Insulated Siding for Energy Efficient Building Envelopes*

10:30-11:00 **BREAK**

11:00-11:30 **ORNL** - *R25 Polyisocyanurate Composite Insulation Material*

11:30-12:00 **Iowa State University** - *Novel Infiltration Diagnostics based on Laser-line Scanning and Infrared Temperature Field Imaging*

12:00-12:30 **ANL** - *Acoustic Building Infiltration Measurement System (ABIMS)*

12:30-12:45 **ET -** *Envelope Wrap-Up [Reviewers and BTO Only]*

Thank You and Contact Info…

Any questions?

My Contact Info:

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