U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Highlights from Building Technologies Office, Residential Buildings Program

Joan Glickman
Acting Program Manager
Residential Buildings Integration
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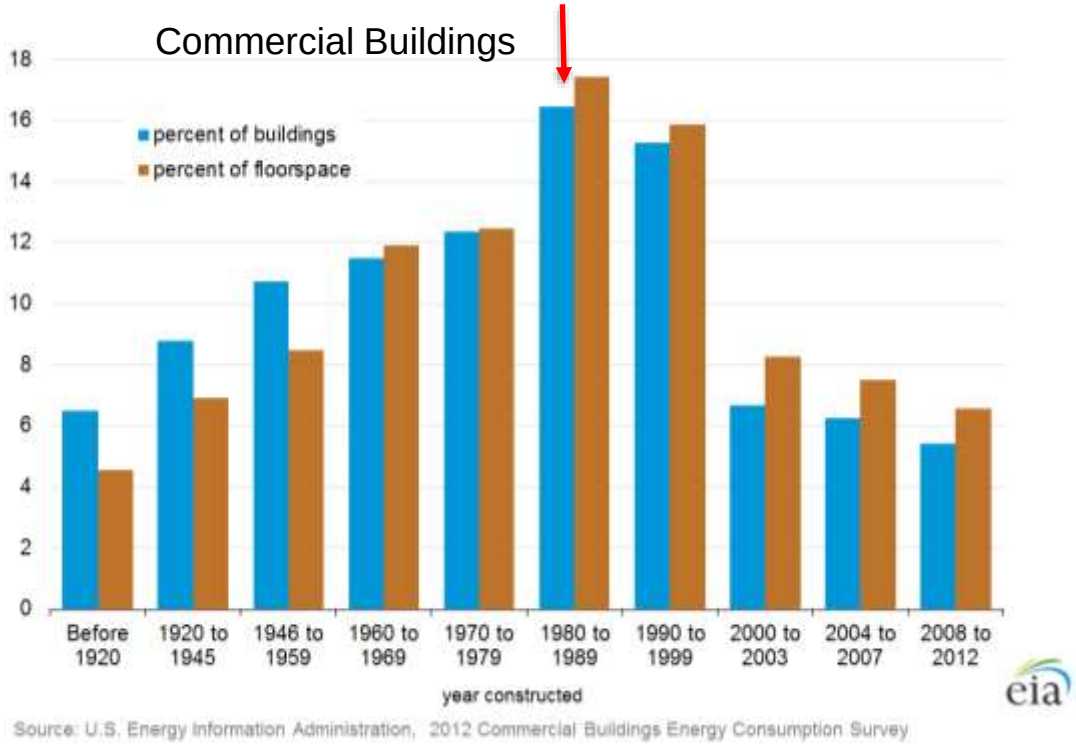
Today's Talk:
Strategic Initiatives for Driving Retrofits

- Advanced Building Construction
- Workforce
- Technology Challenges
- Home Energy Score
- Lifecycle Energy and Carbon Accounting

Half of Our Nation's Buildings > 40 Years Old

Commercial Buildings



Source: U.S. Energy Information Administration, 2012 Commercial Buildings Energy Consumption Survey

- ✓ **Updating our existing buildings generally beats building new efficient ones (from lifecycle energy perspective)**
- ✓ Depending on assumptions…takes between 10 to 80 years to make up the energy used during construction

Residential Buildings

Characteristics	Estimate (millions)
Single Family	80
2 to 4	10
5 or more	20
Mobile/Trailer	7
Total Occupied Units	**118**
Year Structure Built	
2010 to 2015	4
2005 to 2009	8
2000 to 2004	9
1990s	15
1980s	16
1970s	18
1960s	13
1950s	13
1940s	6
1930s	4
1920s	5
pre-1920	8
Median Year Built	**1976**

Current Approach Won't Cut It

Energy retrofits today are…

- ✓ Too slow
- ✓ Too disruptive
- ✓ Too costly
- ✓ Too short on energy savings
- ✓ Not commoditized…

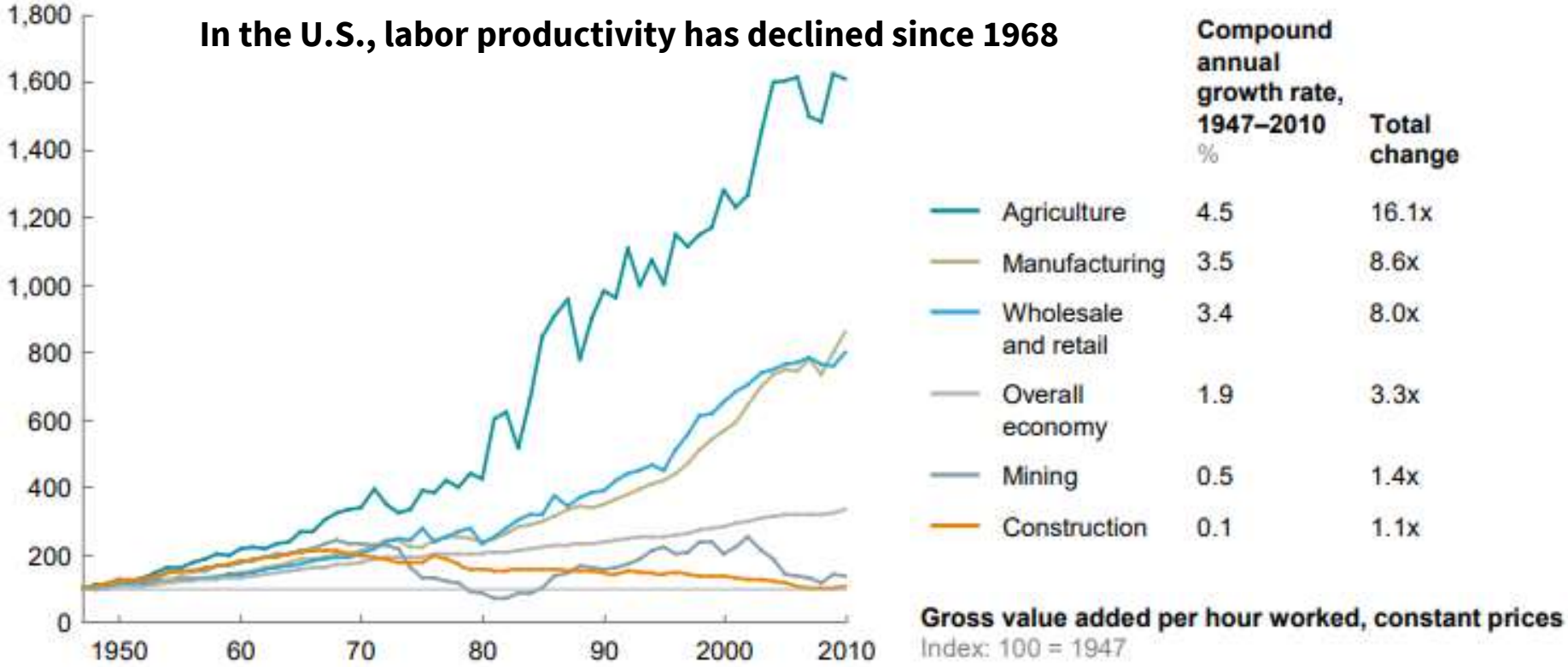
  "I can't buy it on Amazon"

For these reasons, **retrofits are** few and far between, **unappealing to majority of home owners** and **building owners**

U.S. construction sector productivity lagging considerably

Typical construction today is characterized by…

- ✓ Poor productivity compared to other industries
- ✓ Cost and schedule overruns



Source: https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/improving-construction-productivity

ABC: Infuse EE into efforts to modernize construction industry

Vision: A transformed U.S. construction industry that produces highly efficient new buildings and retrofits at scale.

Advanced Building Construction (ABC) means buildings –

- **Designed for high performance in a changing climate**
  - Highly efficient*
  - Low or negative embodied carbon
  - Grid-interactive with valuable grid services
  - Resilient to local disaster risks and other threats
- **Built or renovated with minimum onsite construction time**
- **Affordable and appealing to building owners, tenants, and investors**

***Highly efficient buildings are defined as -**

1) new buildings that are 50% more efficient when compared to current code (i.e., 2018 International Energy Conservation Code and ANSI/ASHRAE/IES Standard 90.1-2016) than 2018 IECC code for new buildings; and

1) existing buildings with an energy use intensity (EUI) for space heating, space cooling, water heating, and ventilation less than or equal to 75% below the median EUI for those loads in the specific building type and location.

One Inspiration for ABC: Energiesprong in the NL

BEAUTIFUL, WARM AND AFFORDABLE

HOMES FOR LIFE.

Transition Zero

Funded by the European Union

Energie Sprong

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696186

ABC Key Areas of Focus

By focusing on the following key areas, ABC technologies and approaches can be validated, prepared to scale rapidly, and tied to a growing market for such products and solutions.

1) Research, Development & Validation
2) Analysis & Tools
3) Market Development
4) Technology Commercialization
5) ABC Collaborative/Stakeholder Engagement

ABC Collaborative

Bringing together diverse stakeholders to inform, advance and help scale ABC

Create technology cohorts

- Facilitate collaboration where linkages between different partial solutions (e.g., envelope, HVAC, software) show promise

Work with federal, state, and local entities interested in --

- Funding complementary research, development and validation of ABC technologies
- Applying ABC solutions

Facilitate "match-ups" between manufacturers and building owners

- Gain commitments from manufacturers to provide ABC technologies; and from building owners to implement ABC projects

Address barriers to scaling ABC technologies and approaches

- Develop expedited 3rd party testing process
- Pursue innovative business models including financing and insurance

Technology Challenges

Challenging industry to fill a market need with an energy saving, new-to-market technology

How Challenges Work…

- Select targeted technology (consider energy savings potential, market appeal)
- Develop specifications
- Garner "soft" procurement commitments
- Issue "challenge" to manufacturers (specs, timeline, testing)
- Involve stakeholders throughout process
- Manufacturers develop products to meet specs
- Equipment purchased & installed

Benefits of this Approach…

- Spurs innovation
- Encourages earlier understanding of consumer interests and industry capabilities
- Links supply and demand by matching prospective end users to manufacturers engaged in challenge
- Strives to disrupt traditional thinking

Technology Challenges – Proven Successes to Date

Prior Challenges/Successes

Wireless Metering Challenge (2013-2017)

- Developed meter under $100 wireless meter
- Exceeded required communication success rate of 95%

RTU Challenge (2010-2012)

- Develop an 18 IEER RTU plus advanced features
- Outcome: Daikin McQuay's Rebel rooftop units reduce energy use by as much as 50%
- At least 7 brands exceed 18 IEER today

High-Performance Rooftop Unit Challenge

Low-Cost Wireless Metering Challenge

Current & Future Challenges

Residential Buildings

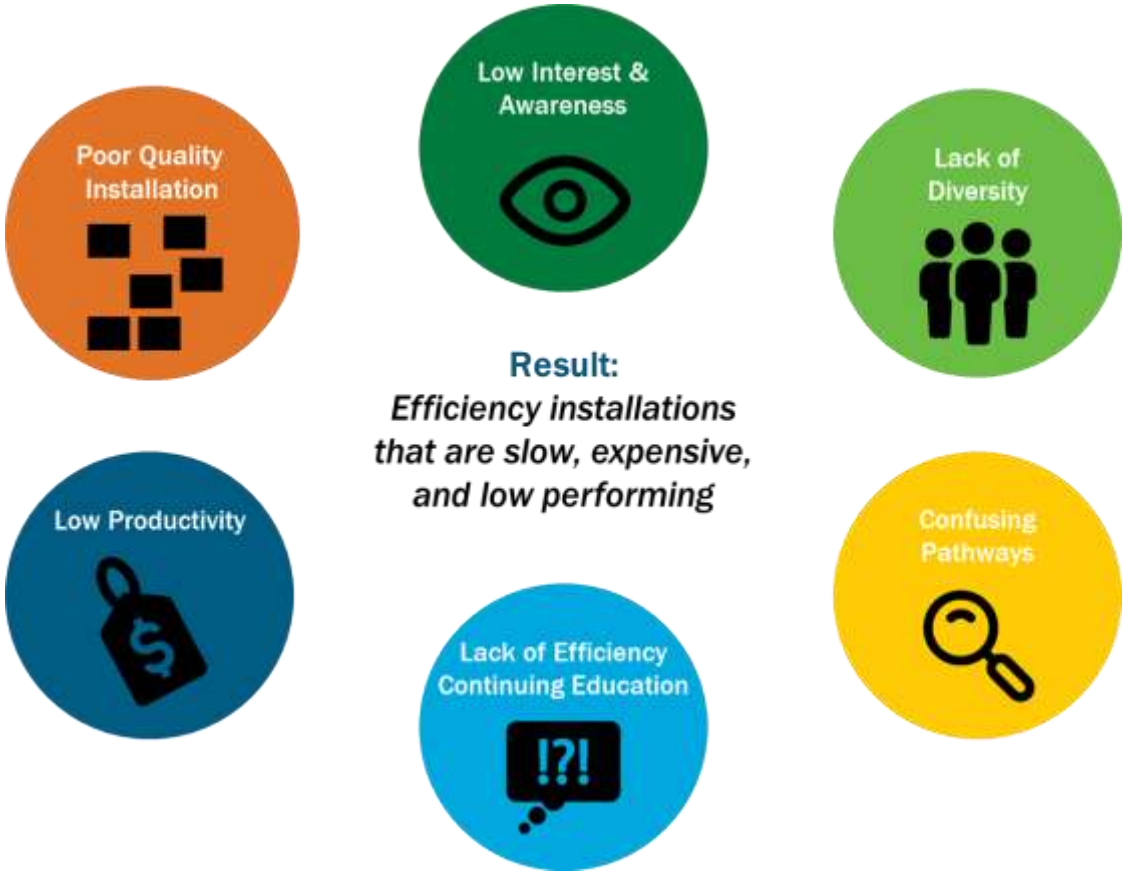
- Automated Fault Detection & Diagnostics in HVAC equipment; other technologies TBD
- * Significant benefits for public housing and other large residential building holders

Commercial Buildings

- IoT Troffer Challenge (2018-2020); additional challenges TBD
  - Goal to develop a competitively priced, USB like port for a IoT-enabled troffer for lighting sensor products
  - Desired outcome: Manufacturer meets the price % increase (e.g 10%) and demonstrate IoT connectivity that is upgradeable and adaptable.

Workforce Development

Challenges in Efficiency Workforce



BTO Areas of Focus

- Support development of workforce training, curricula, and competencies for key jobs
- Engage key stakeholders including sectors that have not traditionally been a focus for BTO (e.g., community and technical colleges, & construction trade educators)
- Launch workforce roundtable to facilitate partner/stakeholder input & engagement
- Coordinate with broader EERE "clean energy workforce" strategy under development

Home Energy Score

Progress Updates

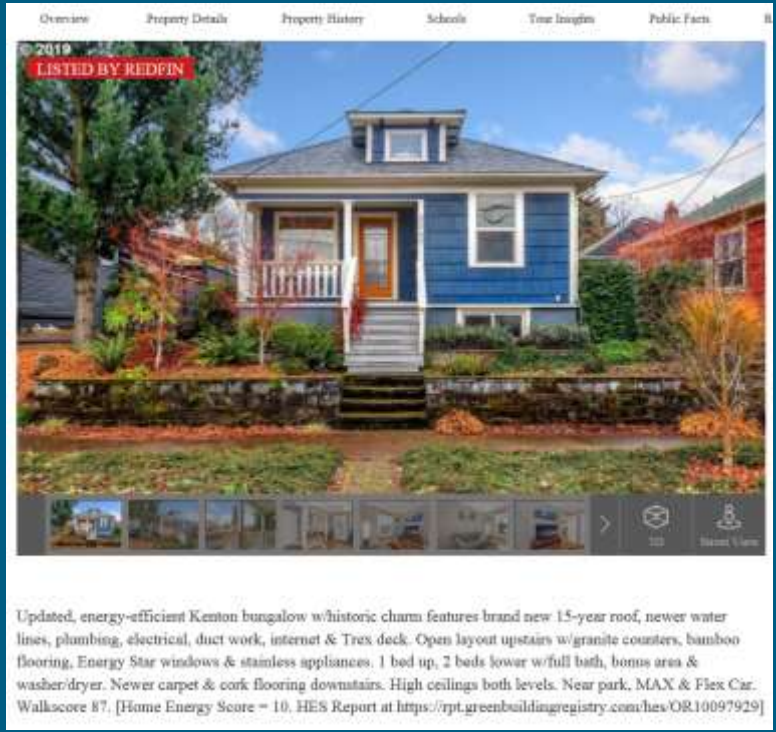
- 130,000+ Home Energy Scores
- State Energy Office programs
  - OR, MO, CT, AK & MA (coming soon!)
- City implementations
  - Portland, OR; Berkeley, CA; Carlsbad, CA; Milwaukie, OR; Denver, CO; and more
- EnergyPlus Modeling Platform
  - More consistency across new & existing homes
- Remote QA & mentoring for nationwide access
- Fannie Mae & Freddie Mac efficiency financing

Online Resources

- Bringing Home Energy Information to Real Estate: A Toolkit
- Home Energy Labeling: A Guide for State and Local Governments
- Residential Energy Efficiency for Local Governments
- Coming Soon! "*Home Energy Labeling: Steps states can take to support city-based home energy labeling*"

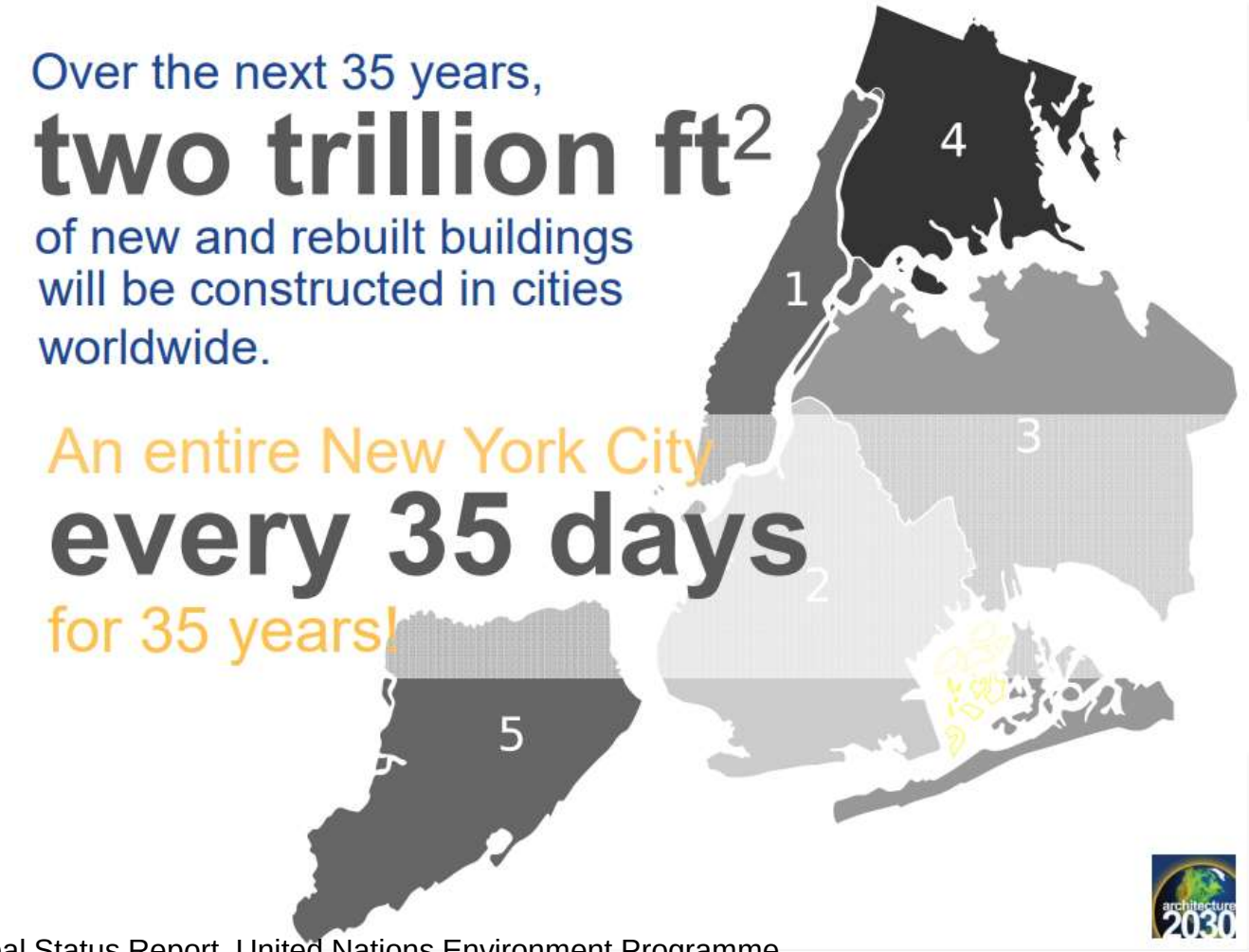
State Spotlight: Oregon

- ✓ ODOE set up framework for cities to easily implement Score
- ✓ Portland, OR requires Score in real estate listings (17,000+ Scores to date)
- ✓ Milwaukie, OR is latest OR city to adopt Score ordinance, more expected



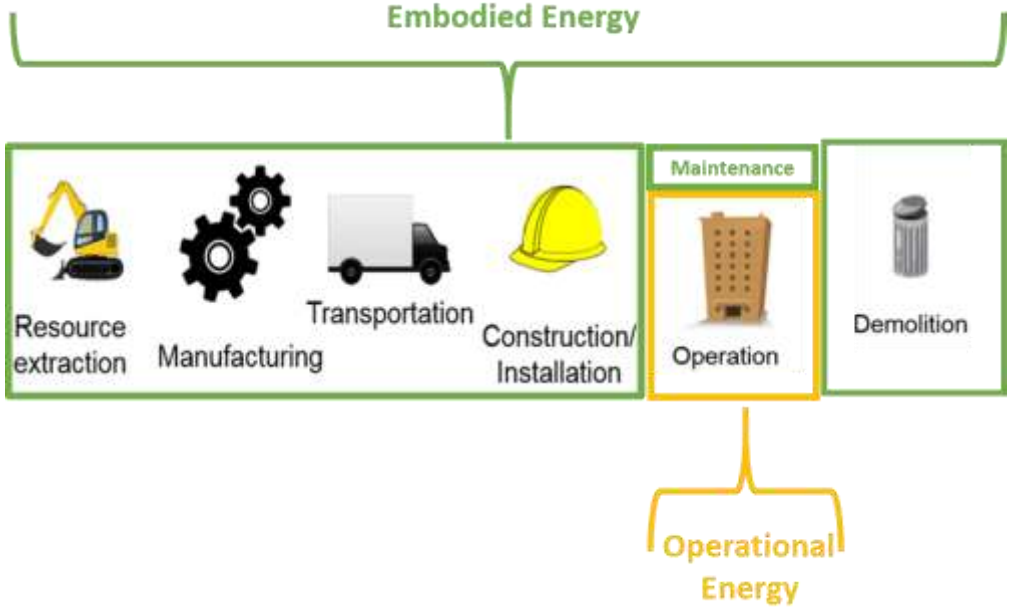
"Updated, energy efficient Kenton bungalow… Home Energy Score = 10"
https://rpt.greenbuildingregistry.com/hes/OR10097929

A Sobering Statistic: Global building stock expected to more than double in area by 2060.

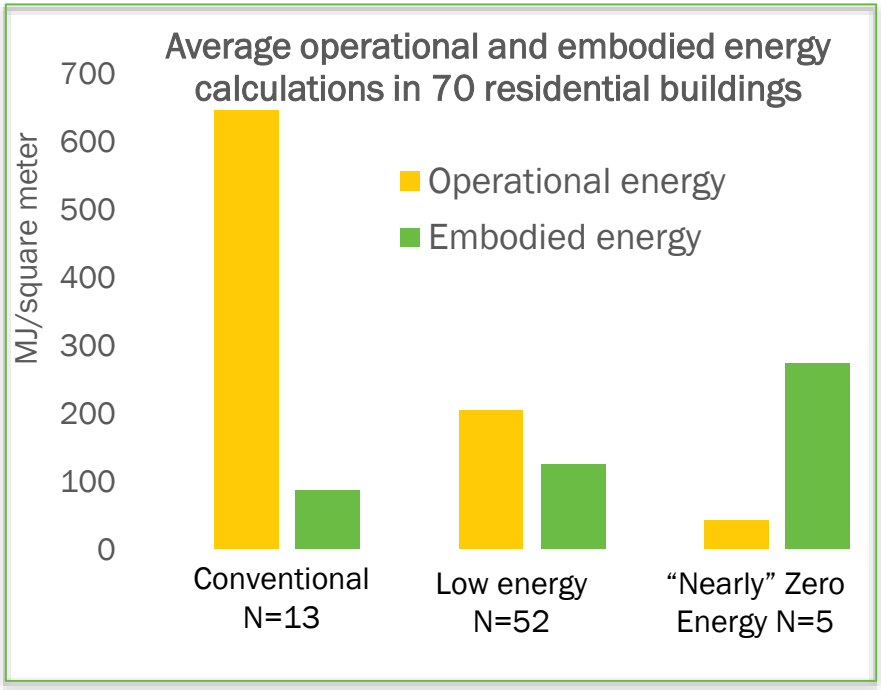


2018 Global Status Report. United Nations Environment Programme.
International Energy Agency for the Global Alliance for Building and Construction (GlobalABC)

Need a Systematic Approach to Lifecycle Energy & Carbon Analysis



Small study highlights the importance of considering both operational and embodied energy as we meet future building challenges.



Chastas, P., T. Theodosiou, D. Bikas. "Embodied energy in residential buildings-towards the nearly zero energy building: A literature review" *Building and Environment* 105 (2016) 267-282.

Joan Glickman

Program Manager (Acting)
Residential Buildings Integration
DOE Building Technologies Office
joan.glickman@ee.doe.gov
202.586.5607 (office) / 202.492.5080 (cell)