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Building Energy Audits for Residential or Commercial Buildings

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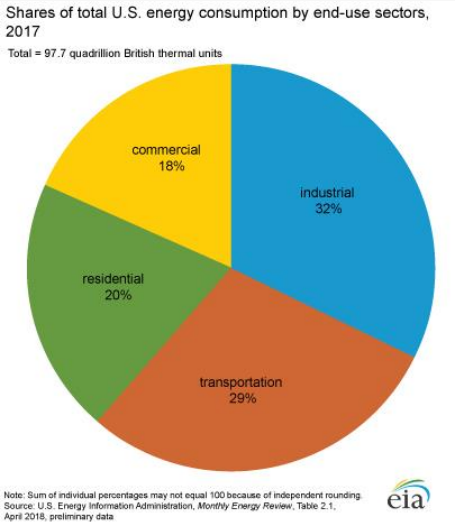
OAK RIDGE National Laboratory
U.S. DEPARTMENT OF ENERGY | Office of ENERGY EFFICIENCY & RENEWABLE ENERGY
BUILDING TECHNOLOGIES OFFICE
NREL NATIONAL RENEWABLE ENERGY LABORATORY

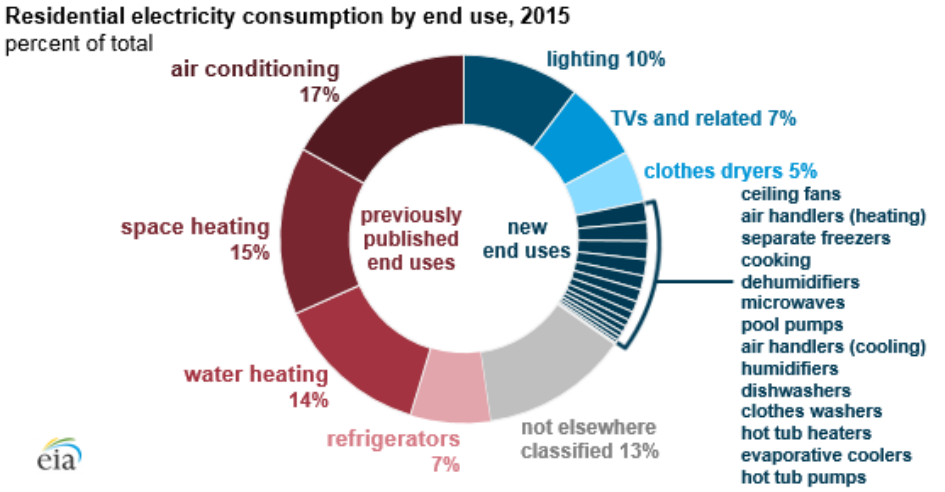
Background

US residential building energy consumption

- Residential building energy use: **20%**
- HVAC consumption: **32%**



Source: https://www.eia.gov/energyexplained/use-of-energy/

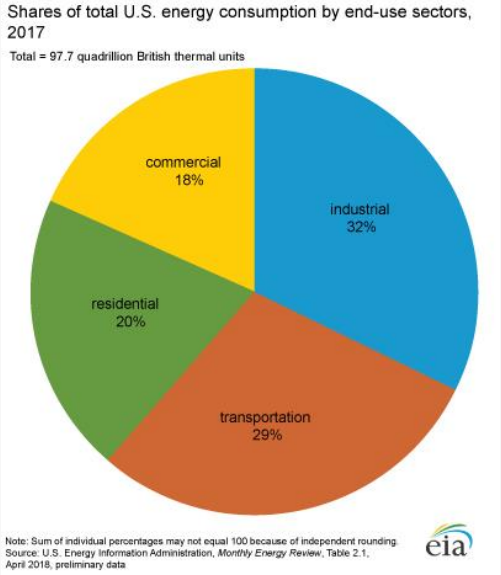


Source: https://www.eia.gov/todayinenergy/detail.php?id=36412

Background

US commercial building energy consumption

- Commercial building energy use: **18%**
- HVAC consumption: **44%**



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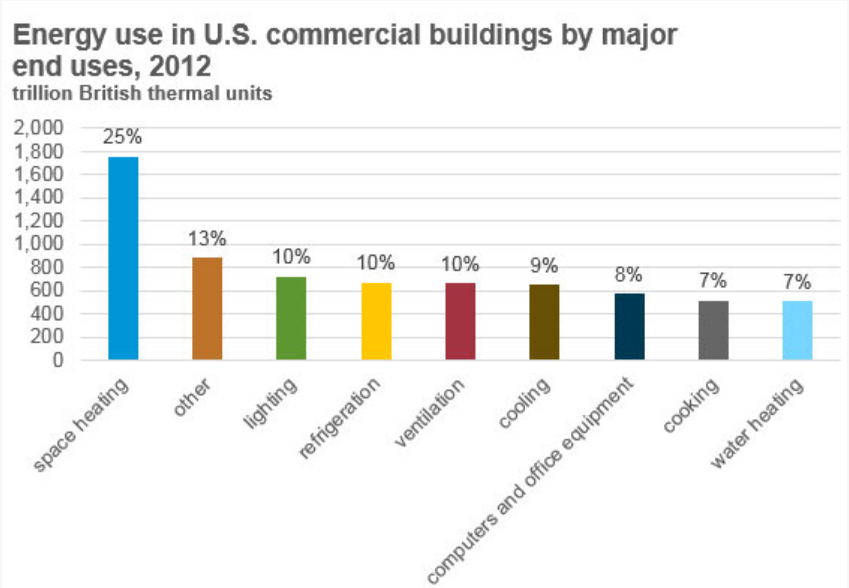


Source: U.S. Energy Information Administration, *2012 Commercial Buildings Energy Consumption Survey: Energy Usage Summary*, Table 5 (March 2016)

Background

The Three Levels of Energy Audits*

- Level 1
  - Walk Through Analysis: Where facility staff are interviewed, energy bills are reviewed and there's a walk through of the property
  - A preliminary report is prepared, offering improvement suggestions and detailing whether a more detailed audit is needed

Source:

https://webberandgrinnell.com/business-insurance/

* American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE). Procedures for Commercial Building Energy Audits (2004)

Background
The Three Levels of Energy Audits

- Level 2
  - Like Level 1, however this offers energy calculations and financial analysis of possible outcomes
  - Utility rates are analyzed to determine if there are rate change opportunities and potential problem areas
  - This level is typically used to identify solutions for the future

Source:

https://webberandgrinnell.com/business-insurance/

Background
The Three Levels of Energy Audits

- Level 3
  - The most rigorous analysis of them all, involves the most field data gathering. Existing utility data that already exists is coupled with sub-metering data as well as continued monitoring of operating systems
  - This level is typically used on industrial and commercial buildings
  - This level is considered investment-grade

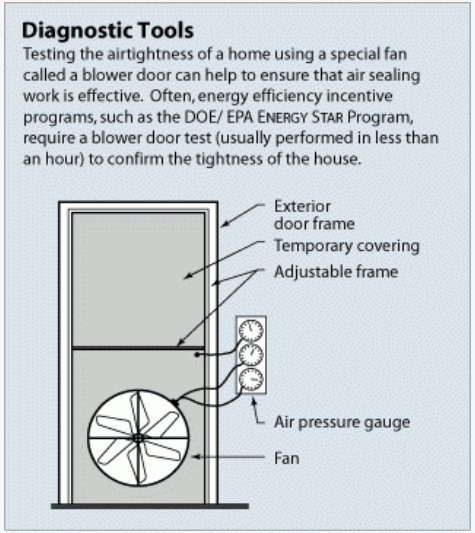
Source:

https://webberandgrinnell.com/business-insurance/

Background
Diagnostic tools

- Common tests for better understanding your energy losses
  - Blower Door Test
    - By using a blower door, the air leakage of the building can be estimated

    Better used on smaller sites or residential buildings



Source: https://www.energy.gov/energysaver/blower-door-tests

Background
Diagnostic tools

- Tracer Gas Test
  - Using emitter and receiver devices, the concentration of a tracer gas in a room can be determined in addition to the rate it circulates through the home
  - Like the blower door test, the tracer gas test can be used to estimate air leakage

Source: https://www.energy.gov/energysaver/pft-air-infiltration-measurement-technique

Background

Current audit tools

- Current audit tools used for residential and commercial buildings
  - Residential buildings
    - REM/Rate: http://www.remrate.com/
    - Home Energy Saver: https://homeenergysaver.lbl.gov/consumer/
    - ORNL Weatherization Assistant: https://weatherization.ornl.gov/softwaredescription/
  - Commercial buildings
    - EnergyPlus: https://energyplus.net/
    - DOE-2: http://doe2.com/

Background

Energy Auditing in Residential & Commercial Properties

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- Developing technical solutions to expedite the audit process or simplified but more efficient energy audit method
- Expanding on previous audit methods or developing your own innovative solution

► **Challenge !!**

Background

Challenges with current energy auditing processes

- Challenges with current energy auditing processes
  - Technical
    - Expertise required
    - Requires more detailed field data
    - Short-term metering/monitoring
  - Cost
    - Energy audits can create a financial strain, especially higher-level audits
    - Time consuming
    - Travel for on-site work pushes up cost

The challenge

Energy Auditing System Design

- The proposed solution
  - Reduce time and cost of energy audits
  - Conduct energy audit at a local building
  - Relate to any level of energy auditing
    - Can relate to multiple levels at once as well
- Many aspects of the building can be considered
  - Building envelope, HVAC system, lighting system
  - To improve current system for energy efficiency and occupants' comfort

The challenge

Requirements

- Response requirements
  - Problem statement
  - Virtual site assessment
  - Energy usage analysis
    - Collect and utilize data (minimum of one year)
  - Potential target buildings
  - Expected impact of the energy audit
    - Examples of impact include energy saving potential using a whole building energy simulation tool (e.g., EnergyPlus, OpenStudio) or other relevant methods to capture the scientific effects of the propose method, economic benefit, and indoor environment improvement
  - Feedback from Staff on Energy Audit Outcomes

The challenge

Requirements

- Response requirements (cont.)
  - A tech-to-market plan
    - How to apply the solution on an aggregate scale
    - How to engage commercial building owners and motivate them to adopt the solution
    - Include a cost and benefit analyses in the technology-to-market plan
  - A description of the benefits for the stakeholder community from the proposed innovative system

Additional Resources

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ASRAE energy audit level 1, 2 and 3
- https://www.smartwatt.com/whats-difference-ashrae-level-1-2-3-audits/

Do-it-Yourself Home Energy Audits
- https://www.energy.gov/energysaver/home-energy-audits/do-it-yourself-home-energy-audits

A guide to energy audit
- https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-20956.pdf

Blower door test
- https://www.energy.gov/energysaver/blower-door-tests

Tracer gas test
- https://www.energy.gov/energysaver/pft-air-infiltration-measurement-technique

Thermographic inspection
- https://www.energy.gov/energysaver/thermographic-inspections

Remote building energy audit
- https://thedaily.case.edu/case-western-reserve-completes-license-option-with-spinout-company-edifice-analytics-inc/

Remote building assessment
- https://www.businesswire.com/news/home/20141211005115/en/FirstFuel%E2%80%99s-Remote-Building-Assessment-Named-Project-Year

Energy analysis tool
- **https://www.johnsoncontrols.com/insights/2020/featured-story/better-energy-analysis-tool**

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Questions or Comments?

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Thank You!