JUMP into STEM
Building Energy Audits for Residential or Commercial Buildings
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Jumpintostem.org
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%

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

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/

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
Current audit tools used for residential and commercial buildings

- Residential buildings
  - REM/Rate: http://www.remrate.com/
  - ORNL Weatherization Assistant: https://weatherization.ornl.gov/software_description/

- Commercial buildings
  - EnergyPlus: https://energyplus.net/
  - DOE-2: http://doe2.com/
Background
Energy Auditing in Residential & Commercial Properties

- 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
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
    o 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

ASRAE energy audit level 1, 2 and 3

Do-it-Yourself Home Energy Audits

A guide to energy audit

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

Remote building assessment

Energy analysis tool
Questions or Comments?
Thank You!