Weatherization/Home Performance

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Learning Objectives

- Discuss the importance of energy use
- Explain why existing buildings matter for energy and other issues
- Discuss the “house as a system” approach to retrofits
- List major retrofit energy efficiency measures
- Identify technology used for assessing energy performance of buildings
- Describe energy efficiency career opportunities
Energy Use in the U.S.

- Buildings use about 40% of all energy in the United States
- Split about evenly between residential and commercial
- The rest is industrial, transportation, and electricity generation
Energy Use in Residential Buildings

Residential electricity consumption by end use, 2015
percent of total

- air conditioning 17%
- space heating 15%
- water heating 14%
- refrigerators 7%
- lighting 10%
- TVs and related 7%
- clothes dryers 5%
- previously published end uses
- new end uses
- not elsewhere classified 13%

Sources:
- Ceiling fans
- Air handlers (heating)
- Separate freezers
- Cooking
- Dehumidifiers
- Microwaves
- Pool pumps
- Air handlers (cooling)
- Humidifiers
- Dishwashers
- Clothes washers
- Hot tub heaters
- Evaporative coolers
- Hot tub pumps

Residential Buildings

- Over 120 million residences in the U.S.
  - About 100 million single-family homes

- We only build about 1.5 million homes a year

- About 90% of homes we’ll have in 2030 are already built!

- Reducing energy use and emissions requires that we consider existing homes while ALSO doing better in new construction
The Environmental Need for Efficiency

- Buildings also account for about 40% of greenhouse gas emissions

- Energy sources are not infinite

- Reducing energy use reduces emissions, helping to limit the worst effects of climate change
The Economic Need for Efficiency

- Energy prices can vary widely
- Many families have difficulty absorbing price changes
- Reducing energy burden improves resiliency of families and leaves more money for other things
The Political Need for Efficiency

- Responds to public demand
- Reduces competition for limited resources
Types of Improved Residential Building Initiatives

- Weatherization/home performance (existing building improvements)
- Green Construction (new construction and remodeling; considers quality and source of materials)
- Net-Zero (new construction)
- Passive House (new construction)
Commercial?

- Small commercial buildings can have a lot of similarities to residential. Key differences:
  - Time of use
  - Cooking
  - Bathing
  - HVAC type
Weatherization/Home Performance

What is it?

- Improvement of existing buildings for efficiency, comfort, and health
- Consider building “as a system” – different components impact one another
- Insulation, air sealing, lighting, refrigeration, HVAC, etc.
- Consider health & safety

- Generally achieves about 20% savings
  - Deep energy retrofits would target 50% or more savings
Weatherization/Home Performance

- Four major measures
  - Air sealing
  - Attic insulation
  - Wall insulation
  - Efficient space conditioning

- Duct leakage can also be major – can be the largest energy penalty in the home!
Air Sealing Materials

• Air barrier materials (solid) for large openings
  o rigid foam board insulation
  o scrap drywall or plywood
• Caulk (for openings less than ½”)
  o type of materials to be caulked
  o amount of joint movement expected
  o weather and temperature conditions
• Spray foams
  o 1-part spray foam
  o 2-part spray foam
Air Sealing

- Seal the big holes first!
Insulation

- Attics – blown cellulose
- Walls – dense-pack cellulose
  - Need to be careful if walls are weak
- Foundation walls – spray foam or faced batts
Efficient space conditioning

- High-efficiency furnaces
- High-efficiency heat pumps
Heat pumps – do it right!

- Can be important toward meeting electrification and climate goals
  - Not always cheaper to operate with current pricing – can be an issue for low-income families unless supports are provided

- Can be severely impacted by duct losses – need to QA/QC ducts!

- Installers need to install properly to maximize benefit of compressor

- Option while we transition: heat pump with gas backup to reduce costs and get much of the heat pump benefit
Duct sealing

- As with other air sealing, use rigid materials to bridge large gaps
- Use mechanical fasteners, not duct tape!
- Then use mastic
Moisture management

- Gutters
- Grading – may require perimeter drains
- Well-installed ground covers
Other common measures?

- Water heater replacement, potentially tankless
- Faucet aerators
- Replace old refrigerators
- New windows and doors (often not cost-effective)
- Efficient lighting (LEDs)
Advanced cooling load management

- Cool roofs, e.g. light colored shingles or membranes
- Strategically planted trees
Numerous programs, for example:

- DOE low-income weatherization assistance program (WAP)
- Utility programs
- Home Performance with Energy Star (HPwES)
- Other state and local programs

- Funding for these has continued to increase!!!

- Intended to address deficiencies in a way that lasts
Customer Benefits

- Reduced utility bills
- Improved comfort
- Can address health & safety problems
- Many measures pay for themselves multiple times over their lifetime
Career Pathways

INDOOR CLIMATE RESEARCH AND TRAINING
Career Pathways

- Building/Home Performance Contractor
- HVAC Contractor with heat pump design experience
- Energy Efficiency Program Director
- Residential Building Code Official (with green building experience)
- Multifamily Quality Control Inspector
- Quality Control Inspector
- Multifamily Energy Auditor
- Healthy Home Evaluator
- Building Performance Crew Leader
- Residential Energy Auditor
- Energy Efficiency Sales Representative
- Energy Efficiency Technician (residential)
- Energy Efficiency Program Assistant
- Building Performance Installer
Certifications

- Many from Building Performance Institute
  - Home Energy Professional Series
    - Energy Auditor -> Quality Control Inspector
    - Retrofit Installer -> Crew Leader
  - Building Analyst
  - Healthy Home Evaluator
  - Air Leakage Control Installer
  - Infiltration/Duct Leakage
  - ...and more!
Business Opportunities

- Business owner - Builder, Remodeler, HVACR, Insulation etc.
- Contractor firm
- Referral system
- Efficiency division
- Program implementer

- All need field staff, office staff
## Business Opportunities

<table>
<thead>
<tr>
<th>Employer</th>
<th>Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>State/Federal Agencies</td>
<td>Government</td>
</tr>
<tr>
<td>CAA (Community Action Agencies)</td>
<td>Private/County Non-Profit</td>
</tr>
<tr>
<td>Utilities</td>
<td>Private</td>
</tr>
<tr>
<td>Utility Implementers</td>
<td>Private</td>
</tr>
<tr>
<td>Contractors</td>
<td>Private/Non-Profit</td>
</tr>
<tr>
<td>Advocacy</td>
<td>Private/Non-Profit</td>
</tr>
</tbody>
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C O O L  T O O L S™ used in building performance

- Blower Door
- Infrared Camera
- Smoke Pens
- Borescope
- Combustion Analyzer
- Gas Leak Detector
- IAQ Monitors
- Energy Monitors
- Smart Home Tech
Blower Door

- Large calibrated fan that depressurizes building
  - 50 Pa = ~20 MPH wind
  - Inflated basketball = 55,000 Pa
  - Used with manometers

- Amount of air through fan == building leakiness
Infrared (IR) Cameras

- IR is part of the electromagnetic spectrum
- Some animals can see in IR
  - Goldfish are special
- Cameras allow you to see heat
  - Building airflow,
  - Electrical issues, body heat
  - FAKE
Energy Monitors

- Power consumption
- Single device or whole house
- Helps focus on problematic or high-consumption devices
Smart Home Tech

- Developing tech with huge potential
- Automate HVAC, lights, appliances, door locks
- Set complicated routines
Summary

- Buildings are very important for energy and other considerations
- There are many opportunities in the building performance industry
- There are several important measures that drive energy savings
- Technology is a key component of energy retrofits