



BDC Presents: Role of Building Envelope

September 14, 2023

Summary:

As state energy offices start putting together their plans for the use of IRA funds, there is a desire to ensure they consider insulation alongside appliance installation. Moderated by Matt Rusteika.

Join us for an engaging discussion with Mike Specian of ACEEE and Charlie Haack of NAIMA (North American Insulation Manufacturers Association).

Resources:

- **Slides:** [BDC Presents Building Envelope .pdf](#)
- **Youtube Recording:** [BDC Presents: Building Envelope](#)
- **California Policy Call:** September 19 at 10am PT, [Register HERE!](#)
- [BDC newsletter sign up](#)
- [Insulation Industry Opportunity Study](#)
- [Empowering Electrification through Building Envelope Improvements](#)

Key Takeaways

Insulation Opportunity in the United States

- ICF performed a nationwide analysis of potential energy & emission savings through insulating residential (single-family), commercial, and industrial buildings finding that energy codes have significantly driven down energy usage. However, there is a large opportunity in existing buildings to reduce energy use because heating and cooling make up over 50% of energy usage in homes and 40% of commercial buildings
- Residential Opportunity
 - Identified by a 4-step process
 - Step 1: Develop baseline conditions for existing homes, finding that the average r-value (measures how well building insulation can prevent the flow of heat into and out of the home) for wood frame wall is 6, unfinished attic average r-value is 25.6 and unfinished basement floor average is 2.7
 - Also found that the average ACH50 (measures the building's air leakage rate with a higher number indicating a leakier house) is 17.4
 - Step 2: Develop upgrade conditions for existing homes, using IECC 2021 where possible
 - Step 3: Assess technical potential savings from insulating all homes, finding that nationwide savings that most households will experience between 20% to 40% in savings
 - Within the report, emission reductions are broken down by state-level

- Step 4: Review cost-effectiveness, finding that no upgrade type is a silver bullet in terms of benefits to costs ratio, but all play an important role
- Commercial Opportunity
 - The same 4 steps are used with a focus on the roof (up to ASHRAE 90.1-2019 levels) and pipe insulation on 6 reference buildings: primary & secondary schools, retail, small and medium offices, and midrise apartments
 - Analysis was also conducted on a state-by-state level and found that on average the benefit-to-cost ratio is 1.42

Building Envelopes

- As electrification occurs, space heating will add a significant load, be a driver of peak load, and potentially stress the grid. One solution is to improve building envelopes. However, quantifying the impact of improving building envelopes depends on whether it is a modest weatherization measure or a deep retrofit.
 - Modest weatherization: minimally invasive weatherization efforts
 - Deep retrofits: weatherization is best done when walls and ceilings are down such as insulating walls, basements, and rim joists, and installing higher efficiency windows
 - Weatherization measures are also most effective in buildings with inefficient building envelopes and buildings in climates with significant heating or cooling demand
- Quantifying the benefits of building envelopes:
 - Energy saving
 - On average, modest weatherization measures can reliably reduce annual energy usage by 12%–18%
 - Deeper retrofits can reduce energy usage by 11%–47%, depending on the state
 - Peak load reduction
 - On average, residential envelope improvements can reduce peak electric load by approximately 7–10%, with only slightly smaller reductions seen in the commercial sector ([source](#))
 - Utility bill savings
 - Weatherization is the critical path to cost-effective electrification from an upfront cost and utility bill cost perspectives as seen in a [brief on Minneapolis](#)
 - The average residential customer who weatherizes an electrified home can expect to save an additional \$150–\$1200/year in operational costs, with most households saving between \$500 and \$800 per year
 - Weatherization is even more critical for low-income buildings because on average, they are 20% less efficient and have more than twice as much air leakage ([source](#))
 - Greenhouse gas reduction
 - On the demand side, the majority of CO₂ reductions come from improvements to envelope, HVAC, and water heating ([source](#))
 - An important note, the importance of envelope improvement grows with time, offering 40-50% greater reductions in 2050 and 2030 compared to other measures highlighting the need to focus on thermal end-uses and reducing the flow of heat between the interior and exterior environments in energy efficiency planning.

Q & A

1. The electrification efforts and goals are going to impact an already stressed grid. **What actions are being taken by the government and other agencies to encourage insulating and envelope sealing to reduce that impact?**
 - The insulation industry is doing its best to promote the prioritization of envelopes before electrification measures are installed. A lot of it comes down to marketing and helping people understand the value of something they usually cannot see behind closed walls or in an attic.

2. **The large benefits of insulation have been well-known since the 1960s or 1970s. Why are we lagging so much, decades later, in realizing those energy savings?**
 - Energy efficiency is invisible. Previously, there was no way to assess how efficient a building envelope is which made investing in building envelopes a financial disincentive. However, now with the blower door test and and Pearl certification, better building envelopes increase the value of the home
 - Updating building envelopes is more disruptive and takes longer than other efficiency measures so households tend to go for other efficiency measures. In addition, so far, energy costs have been so low that there has not necessarily been a driver for updating homes for cost purposes. Most people never think about insulation replacement or an upgrade because it is not something we inspect, maintain, or service because of breakdown or otherwise think about unless prompted or there is a pain point so there is one key disconnect we have to continue to work on to help create top of mind awareness.
 - However, in recent decades, heat pumps have become more available, peak loads are increasing, and decarbonization and electrification are being discussed more often bringing building envelope back into the conversation. In addition, IRA funding could encourage more investment into updating building envelopes.
 - Another key question is with IRA funding, should states require weatherization with electrification updates? This is something all states need to consider in relation to other electrification and efficiency measures.

3. Weatherization work is important, but it has to be properly done. Missing one wall cavity can impact the whole building envelope. **How is the weatherization workforce today and how do we keep it growing?**
 - To best understand the workforce, we should always start with a workforce potential study: how many people are in your region that can do the work now and where are they located? From an equity standpoint, it might also be helpful to understand the demographics of the workers. In general, it will be important for us to build a robust and diverse workforce.
 - Second, it is critical to understand the goal point of weatherization/ decarbonization. For example, if there are city-wide goals for emission reductions, you can work backward by knowing the goal. Then map out which buildings need to be updated and then map that on the existing workforce. That allows the city to understand where the gaps are in meeting its goals.
 - In terms of how do we keep this workforce growing, this could be a long conversation but the DOE has money to invest in job training and utilities could do pre-apprentice trainings to start growing the workforce.