

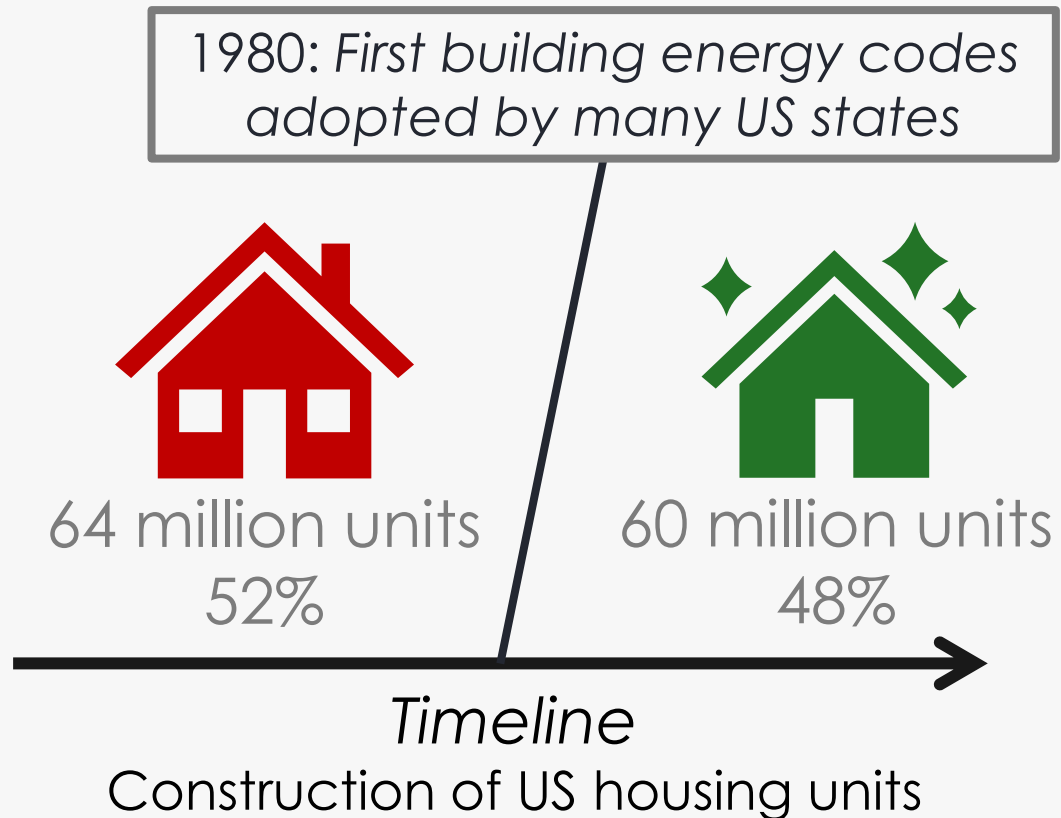
# *jump* into STEM

## That's A Wrap!

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# Context

## Aging Housing Stock

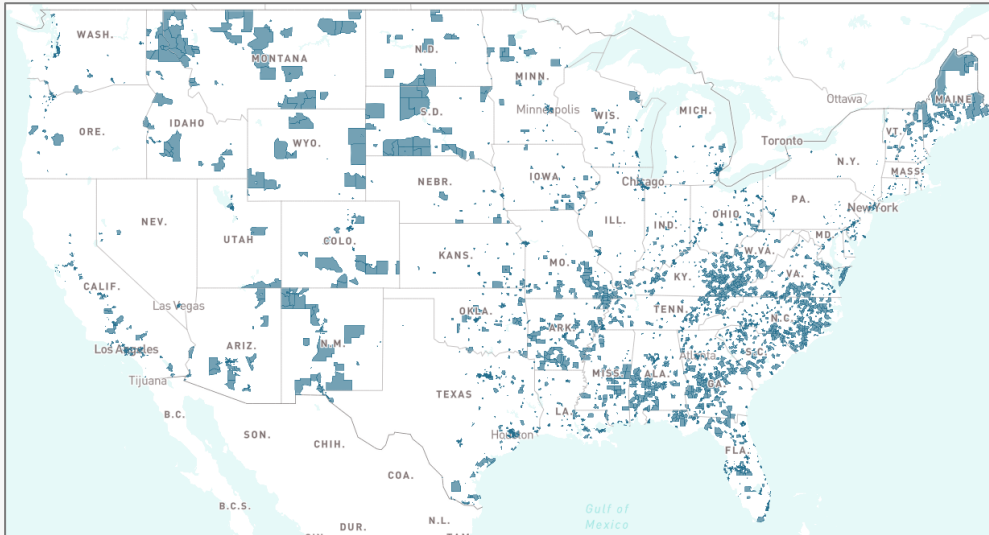


- More than 50% of US residential units were built before 1980.
- Less than 2% of US buildings are retrofitted each year.
- Cost of a home retrofit often exceeds thousands of dollars for the owner.
- **Energy burden** reduces accessibility of retrofits for homeowners.

Source: <https://www.eia.gov/consumption/residential/data/2020/>

# Context

## Energy Burden



Energy burdened  
communities in the US

Source: <https://energyjustice.egs.anl.gov/>

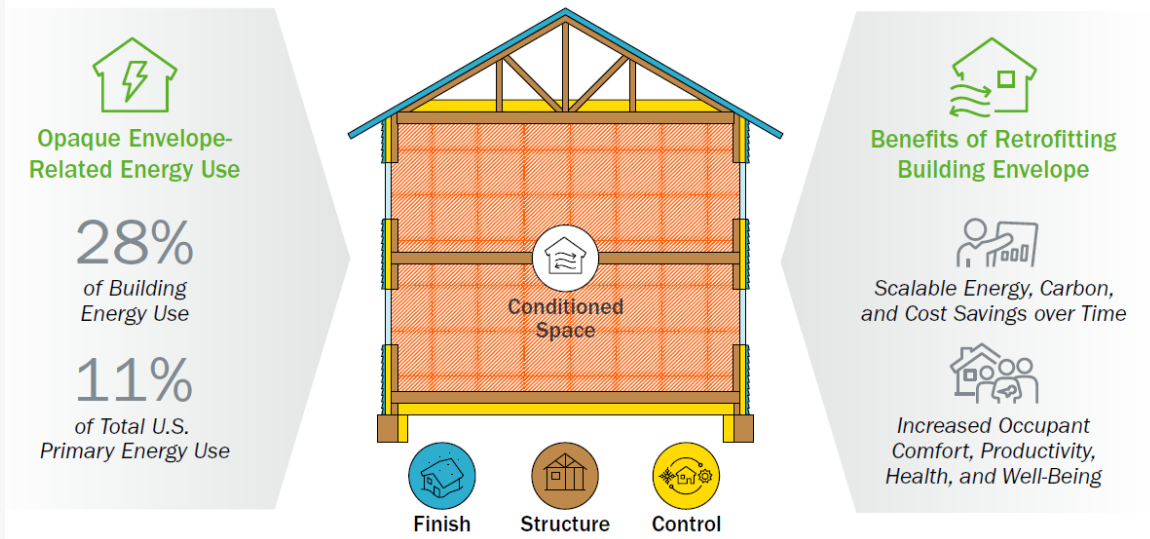
- **Energy burden** is the percentage of a household's gross annual income spent on energy costs.
- Low median income households are disproportionately affected by **energy burden**.
- Households may forgo other life necessities to address issues with the **building envelope**.

# Context

# Building Envelope

## Importance of the Building Envelope

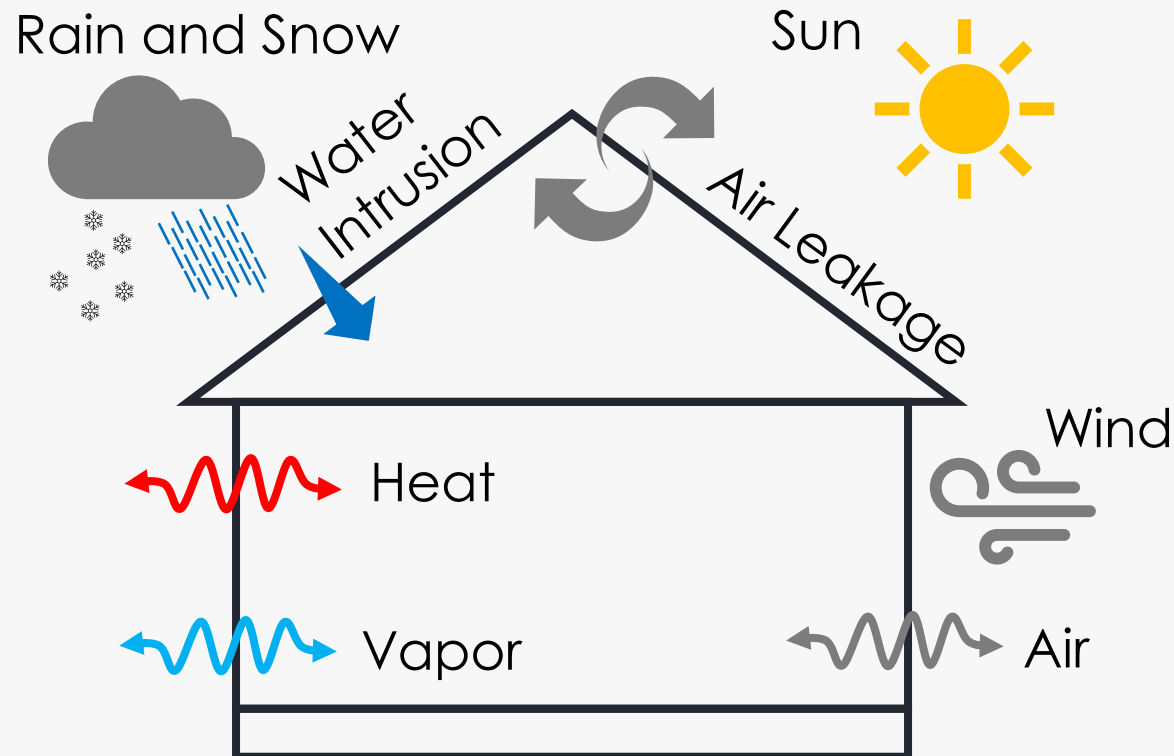
The interface between the indoor and outdoor environments that helps maintain occupant comfort.



Source: <https://www.osti.gov/biblio/1821413>

- The **building envelope** (or building enclosure) serves three main purposes:
  - Support to resist structural loads
  - Finish to provide aesthetics
  - **Control** the flow of matter and energy
- The **control** of matter and energy flow is key to energy efficiency.

# Building Envelope – Control



- The **building envelop** must **control** the flow of:
  - Water
  - Air
  - Heat
- Most strategies to **retrofit** or **remediate** the **building envelope** are **expensive**, **time-consuming**, and **inaccessible**.



# Motivation

The **building envelopes** of older buildings need **retrofit** to increase **energy efficiency**. However, current remediation strategies and technologies are **expensive, slow, and inaccessible** to **energy burdened** communities.

# Building Envelope Retrofits Moisture Damage and Durability



- **Moisture intrusion** can lead to extensive damage of the envelope and present significant health risks to occupants.
- **Moisture control** techniques include air sealing, cladding, flashing, water barriers, vapor barriers, and more.

Extensive damage due to moisture intrusion

Photos (a) and (b): Exterior damage

Photos (c) and (d): Interior damage

Source: <https://www.osti.gov/biblio/1821413>

# Building Envelope Retrofits

## Air Leak Detection and Sealing

Building  
pressurization by  
blower door



Source: <https://www.osti.gov/biblio/1821413>

Caulk  
application to  
window frame



Source: <https://www.energy.gov/energysaver/caulking>

- **Air leaks** can be detected **manually** or by using a **building pressurization** test.
  - Time-consuming
  - Expensive
  - Requires expertise to conduct
- **Air sealing** techniques include caulking, weather stripping, foam sealing, air barriers, and more.



# Building Envelope Retrofits Adding Insulation



Insulation methods for existing walls  
Photo (a): Drill and fill for wall cavities  
Photo (b): Overclad insulation retrofits

Source: <https://www.osti.gov/biblio/1821413>

- **Energy efficiency** of the **envelope** can be improved by adding **insulation** to the roof, walls, or foundation.
- Techniques to add wall **insulation** to older buildings are **expensive, time-consuming, and inaccessible.**

# The Challenge

This challenge asks student teams to address the high energy burden that some communities face by developing an innovative solution that enables building owners to access high-quality and affordable envelope remediation or construction technologies, strategies, or methods.

# Additional Resources

## Residential Energy Consumption and Housing Stock Resources

- <https://www.eia.gov/consumption/residential/data/2020/>

## Energy Burden Resources

- <https://energyjustice.egs.anl.gov/>
- <https://www.energy.gov/scep/slsc/low-income-community-energy-solutions#:~:text=Energy%20burden%20is%20defined%20as,which%20is%20estimated%20at%203%25.>

## Building Envelope Resources

- <https://betterbuildingsolutioncenter.energy.gov/alliance/technology-solution/building-envelope>
- <https://www.energy.gov/energysaver/weatherization>

# Additional Resources

## Moisture Control

- <https://www.energy.gov/energysaver/moisture-control>
- <https://www.epa.gov/mold/what-are-main-ways-control-moisture-your-home>

## Air Sealing

- <https://www.energy.gov/energysaver/air-sealing-your-home>
- [https://www.energystar.gov/saveathome/seal\\_insulate/why\\_seal\\_and\\_insulate](https://www.energystar.gov/saveathome/seal_insulate/why_seal_and_insulate)

## Insulation

- <https://www.energy.gov/energysaver/insulation>
- <https://www.energy.gov/energysaver/types-insulation>



# Thank You!

[www.jumpintostem.org](http://www.jumpintostem.org)