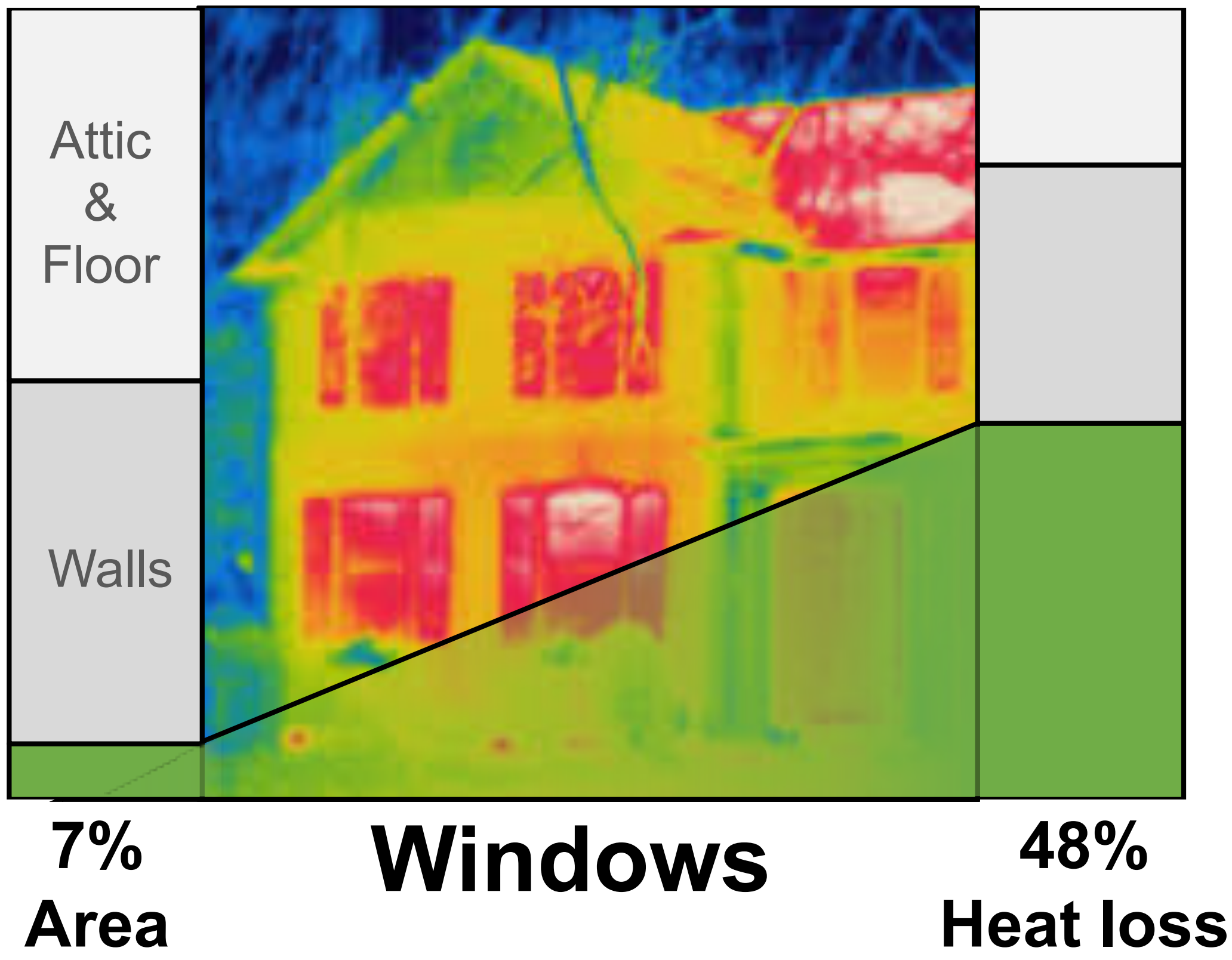


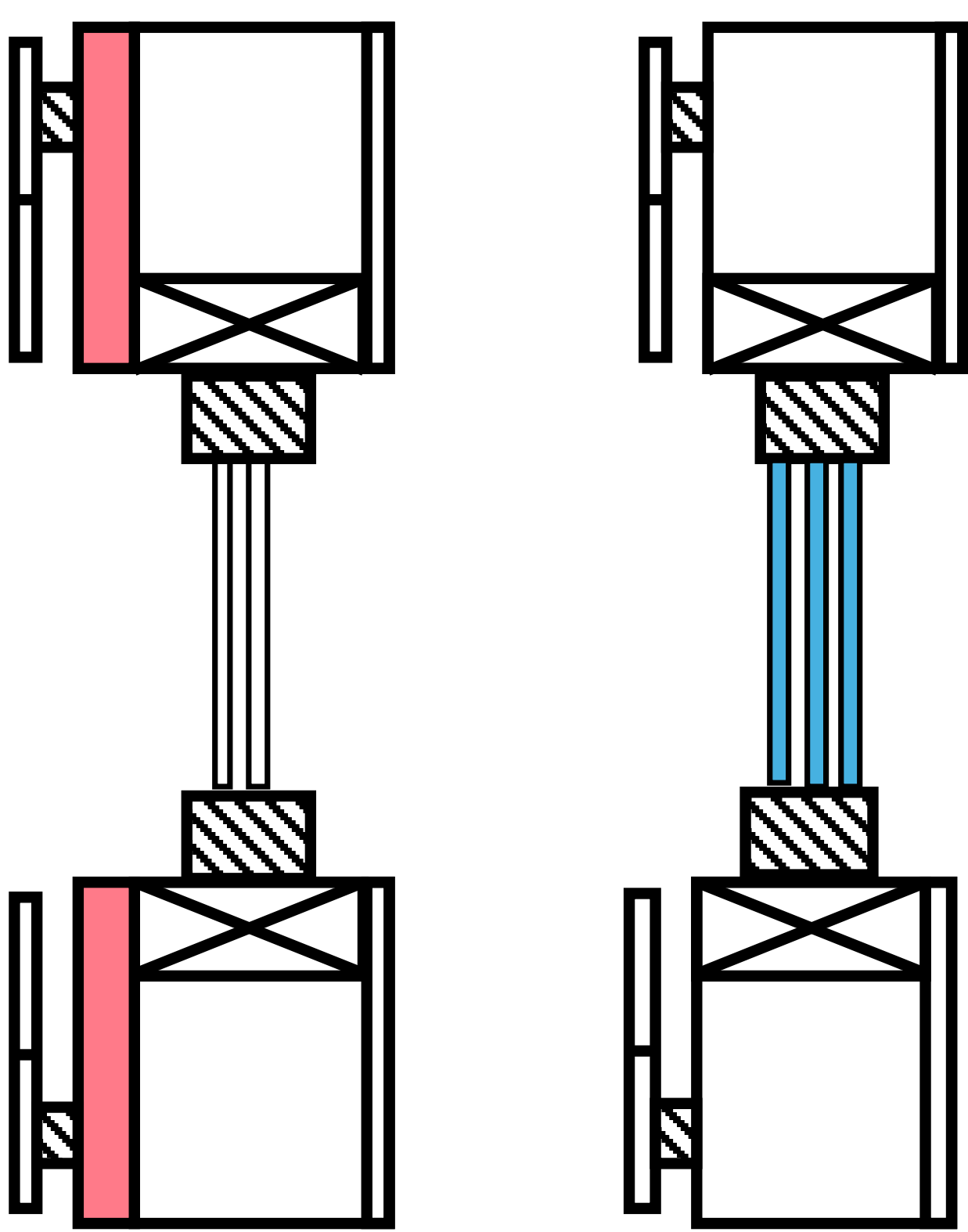
Opportunities For Advanced Windows



Windows Enable High Performance Buildings

High-performance windows play a key role in enabling the electrification of buildings by improving energy efficiency of the thermal envelope. High-performance windows allow buildings to maintain comfortable indoor temperatures more effectively, reducing annual and peak loads, making the transition to electric-powered heat pumps and other renewable energy systems more viable.

To get an average whole-wall R value of R-19 with double-pane windows, you'd need walls 6.5 feet thick, filled with R-330 of insulation!

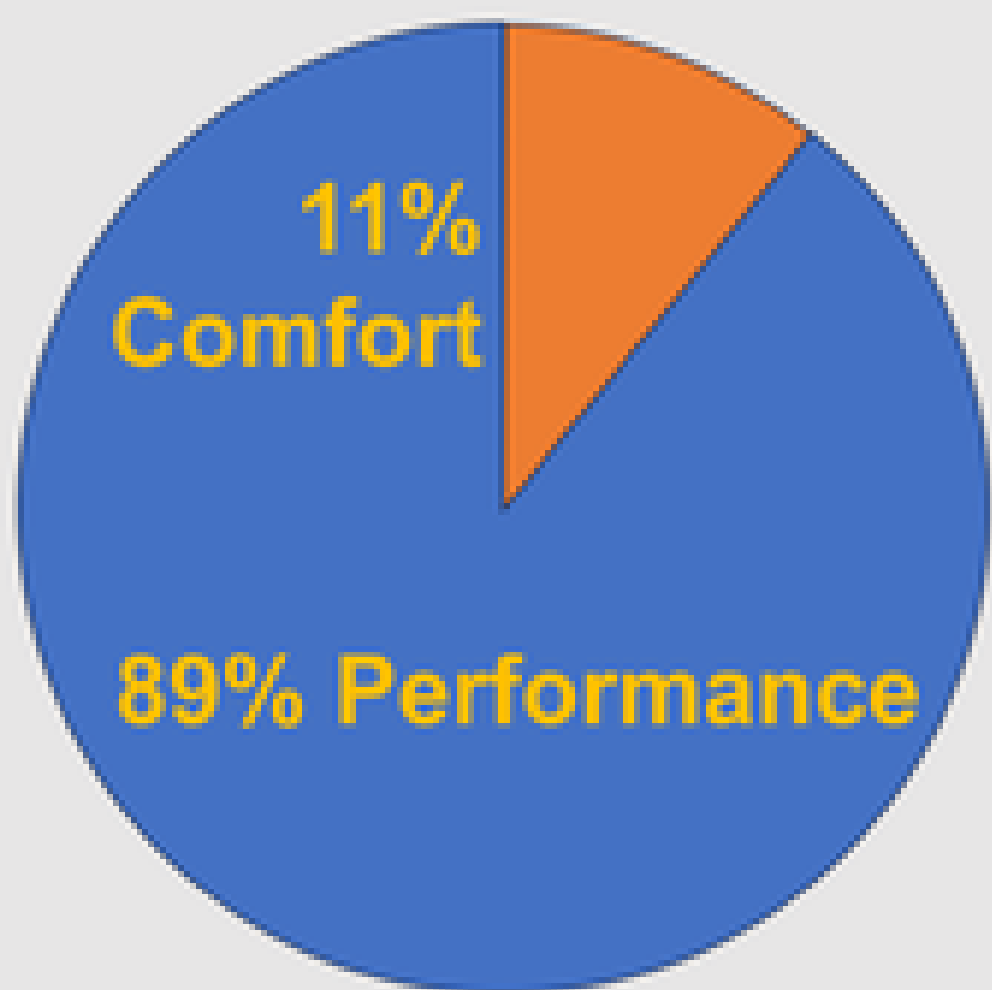


2021 IECC	Compliance Path	Tradeoff Path
Wall Insulation	CZ 3: R20 or R13+5 or R0+15 CZ 4-8: R20+5 or R13+10 or R0+20	CZ 3: R13 CZ 4-8: R20 or R13+5
Windows	U=0.30 (Double-Pane)	U = 0.20 (triple-Pane)

Why Windows Matter

Windows play a critical role in buildings, impacting energy efficiency, comfort, and overall well-being. Energy-efficient windows help reduce heat loss or gain, lowering energy consumption and utility bills, while also maintaining a comfortable indoor temperature. They allow for daylighting and create a more pleasant, productive, and healthy space. Windows also provide a connection to the outdoors, offering views that improve mental well-being and satisfaction. Additionally, well-designed windows promote healthy living by allowing fresh air in through natural ventilation and filtering out harmful UV rays, all while contributing to the aesthetics and functionality of a building.

Primary Reason for using High-Performance Windows



6% to 17% reduction in heating loads.
"Window performance is absolutely going to make a difference in HVAC sizing. You could go crazy with your walls and roof, and if you have poor windows, it will seriously undermine that."

Can specify smaller HVAC systems.
"It drops our furnace size from 30,000 BTU to 15,000 BTU."
"We can spec ductless mini-split heat pumps instead of central systems."

In Builders Own Words

Can install duct registers on inside walls rather than over windows.
"I can do shorter duct runs when I have better windows. The registers don't have to be blowing directly on the windows."
"50% reduction in duct length."

Better HERS scores.
"I definitely see it in the HERS modeling. If I were to switch to a regular ENERGY STAR double-pane window, it would increase my HERS score 10%-20%."

Much warmer in winter.
"You can sit next to the window in a T-shirt in the winter."

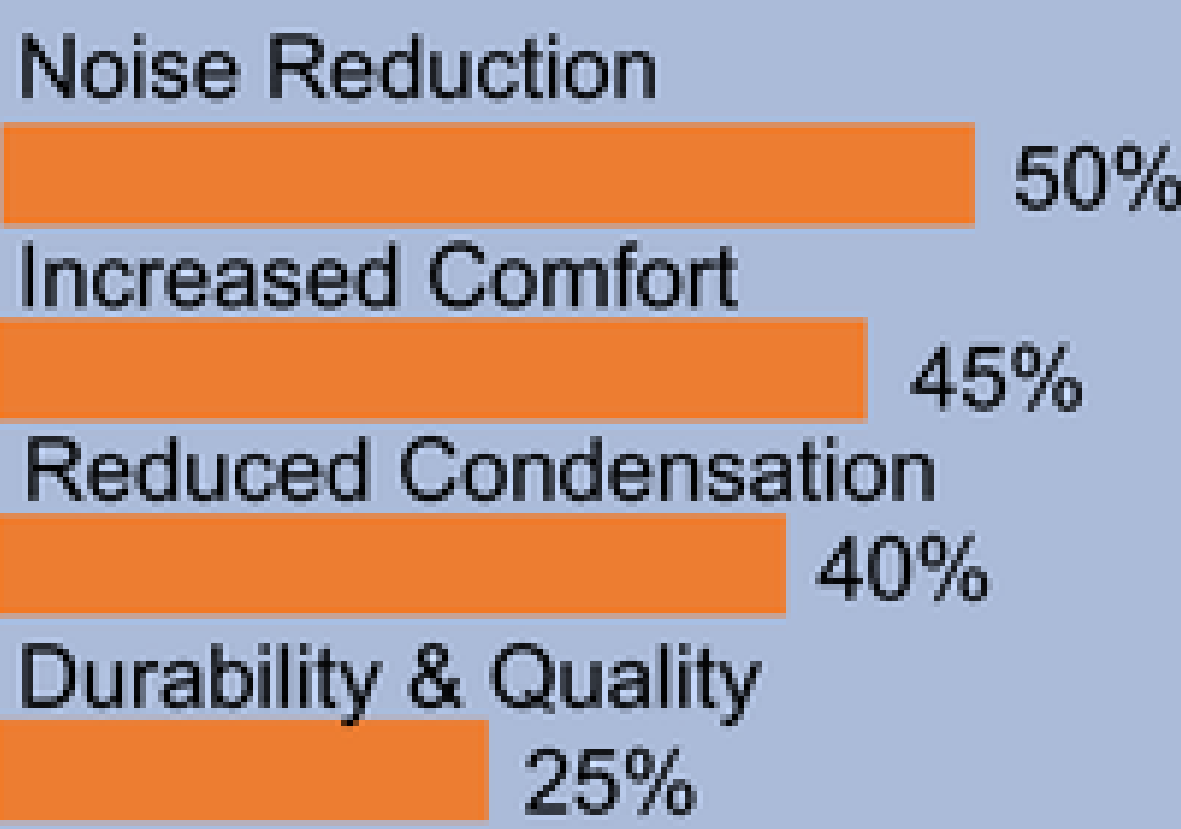
Much quieter.
"We're in the landing path and you can't hear the airplanes directly overhead."

Much less condensation.
"No more mold and ice on the inside of the windows."
"Homeowners don't like puddles on the window sills."

From 2 to 4 ton down to 1 ton in cooling loads.
"Our HVAC capacities are about one-fourth the size of the central heat pumps or air conditioners that would typically be recommended."
"We see much less summer heat gain if we use better windows."

Reduces HVAC equipment costs.
"Switching from my U=0.18 triple-pane to U=0.27 double-pane windows would increase my HVAC system costs by about 15%."

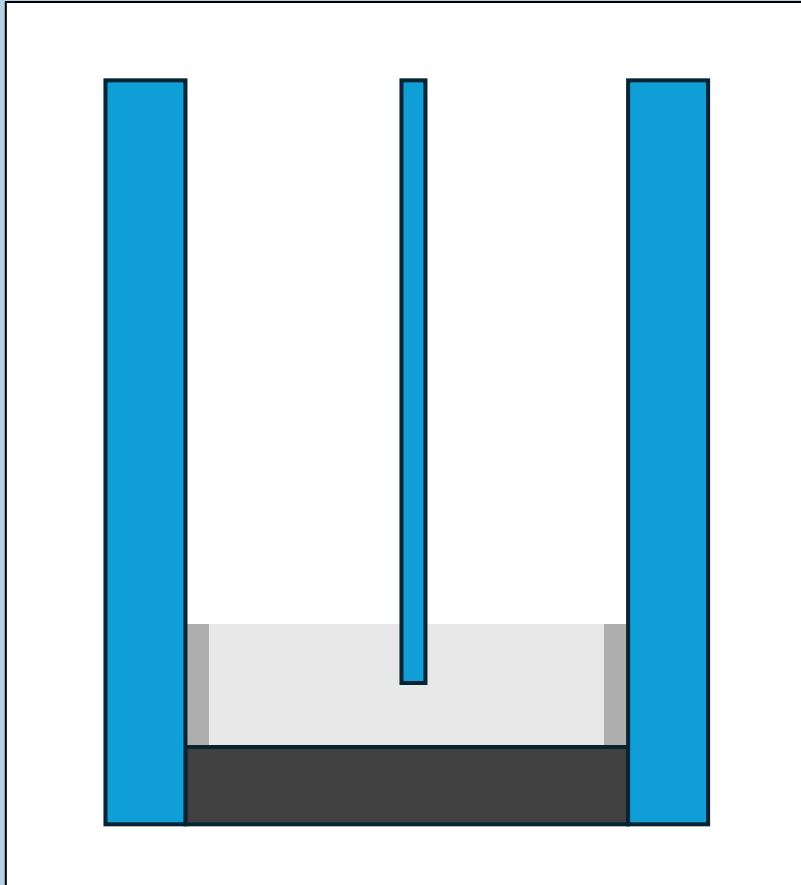
Secondary Benefits



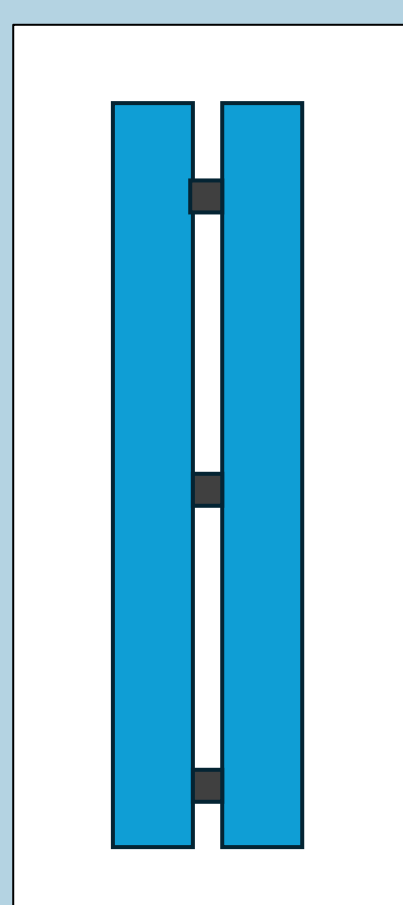
Source: Gilbride et al. 2023. Double or Triple? Factors Influencing the Window Purchasing Decisions of High-Performance Home Builders, PNNL-28789.

Highly Insulating Tech of the Future

Thin-triple insulated glass units (IGUs) are high-performance window systems consisting of three layers of glass with a thin central pane. This design enhances thermal insulation, improves energy efficiency and comfort while maintaining the slim profile and weight of double-pane windows which are typical in the US market.



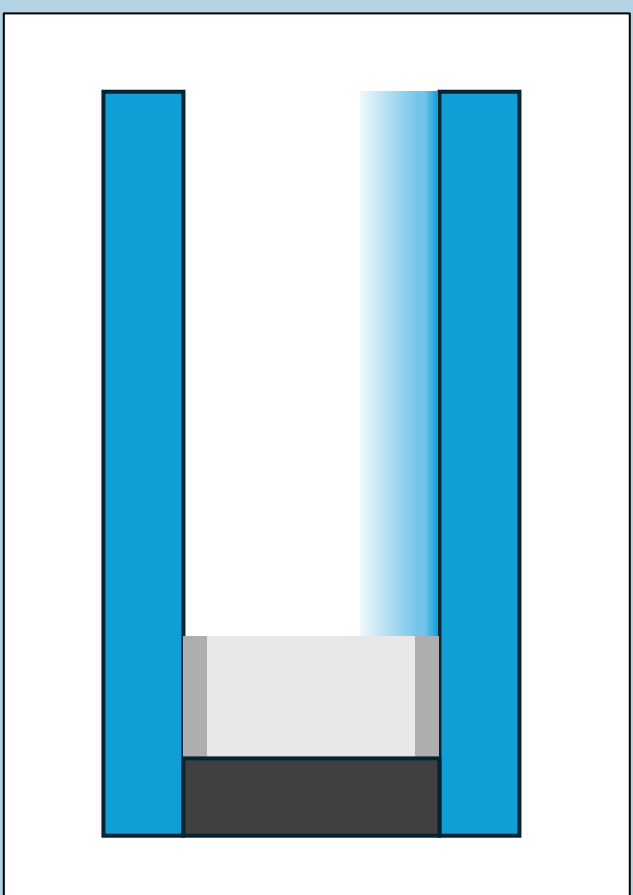
Thin Triple



VIG

Vacuum insulated glass (VIG) is a highly energy-efficient glazing system that consists of two glass panes separated by a thin vacuum space, supported by small pillars. This vacuum layer provides superior thermal insulation, making VIGs an excellent choice for improving energy performance while maintaining a slim, lightweight profile. VIG can be used as a replacement option for single glazing

Aerogel glazing is an emerging technology that incorporates a translucent aerogel material between glass panes, offering exceptional thermal insulation while allowing natural light to pass through. This advanced glazing technology significantly reduces heat transfer, making it ideal for improving energy efficiency in buildings without sacrificing daylighting.



Aerogel

Partnership for Advanced Window Solutions (PAWS)

The Partnership for Advanced Window Solutions collaborative promotes cost-effective, high performance window solutions for the nation's new and existing building stock. The Collaborative includes government agencies and research organizations, regional energy-efficiency groups, utilities, builders and window-solutions manufacturers.



More info: <https://www.paws.energy/>

Highly Insulating Windows

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