

# High-Performance Windows



Windows are wonderful devices—they enable us to see outside of our homes, provide natural light, and may be opened to provide ventilation. But windows, particularly inefficient ones, are effectively holes in the insulated envelope through which a great deal of energy can flow. This tends to make energy meters run faster, ultimately resulting in higher utility bills. If a well-insulated wall (R-25) has 15% of its area glazed with conventional insulating glass windows (R-2), conductive losses through the windows are 2.2 times the conductive losses through the remainder of the wall.

## NEW WINDOWS?

If your windows are double-pane and in good shape, it is probably most cost effective to boost their efficiency with low cost retrofit measures such as caulking and weather stripping. But if you are building a new home, or if your windows are old, uncoated single pane or showing significant wear, you should consider investing in new high-performance windows. High-performance windows can improve comfort and reduce both heating and cooling costs.

When choosing new or replacement windows, energy-efficiency, appearance, and cost are key considerations. Consider this:

- ☀ In some cases, high-performance windows can pay for themselves within two to ten years, depending on the windows being replaced and energy usage in the home.
- ☀ High quality, energy efficient windows can greatly increase resale value.
- ☀ In new homes, high-performance windows may allow for installing smaller, less costly heating and air conditioning systems.

To evaluate energy performance of windows, it is useful to understand how leaky they are (leaks cause convective losses), how conductive they are (low resistance to heat transfer means high conductivity) and how much radiant energy can pass through them.

The National Fenestration Rating Council certifies the performance of windows. The two key factors on NRFC labels are:

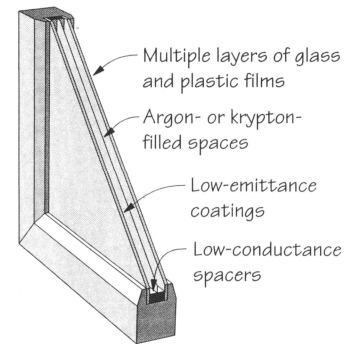
- ☀ **U factor**, the overall conductivity of a window. The U-factor is the reciprocal of R-value and is the rate of heat loss through a window system (which counts its frame) measured in Btu per hour per square foot per degree Fahrenheit (Btu/h-ft<sup>2</sup>-°F). The lower the U-factor, the better. Glass itself is a fairly good conductor (a bad insulator), so its U-factor is quite high (and R-value low). When part of a single-glazed window system, most of the R-value of the system results from the still air layer immediately next to the pane on the inside and the not-so-still air space on the outside. Adding more layers of glazing (or suspended film) adds more still air spaces. Substituting an inert gas for air lowers the U-

	<b>World's Best Window Co.</b> Millennium 2000+ Vinyl-Clad Wood Frame Double Glazing • Argon Fill • Low E Product Type: Vertical Slider
<b>ENERGY PERFORMANCE RATINGS</b>	
U-Factor (U.S./I-P) <b>0.35</b>	Solar Heat Gain Coefficient <b>0.32</b>
<b>ADDITIONAL PERFORMANCE RATINGS</b>	
Visible Transmittance <b>0.51</b>	Air Leakage (U.S./I-P) <b>0.2</b>
Condensation Resistance <b>51</b>	—
<small>Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information. www.nfrc.org</small>	

factor of the space even more.

- ☀️ **Solar heat gain coefficient (SHGC)** is the fraction of solar heat transmitted through a window system (plus absorbed energy that ends up supplying heat inside) with respect to the amount of solar heat that would flow through an unimpeded opening of the same size. Its value can range between 0 and 1. SHGC of clear single and double-glazed window systems run from 0.7 to 0.9, whereas windows with spectrally-selective glazing typically run from 0.2 to 0.5.

Adding thin chemical coatings to one or another surface of glass or film plus filling window systems with inert gasses can allow for “tuning” windows. This can lower their conductive losses while allowing only selected portions of the solar spectrum to pass through the window.



Modern windows have low conductive frames, either via strategically-located thermal breaks in aluminum frames, or by using wood, vinyl, fiberglass, often housing an insulation such as urethane in their cores.

In general, modern windows can have much better insulating properties than older style windows, but this usually comes with lower solar heat gain. In Boulder, simple clear double glazed windows with high SHGC are best for southern exposures where solar energy can supply very welcome gain in the winter. An overhang to prevent overheating in the summer is strongly recommended. For other facades, low U windows are the best choice, particularly on the north. Operating shading devices, particularly if on the outside, are very helpful for east and west-facing facades to prevent overheating due to low angle summertime sunshine.

Windows with vinyl frames are the least expensive, but have relatively shorter lives because ultraviolet rays of Colorado’s bright sun have deleterious effects on plastics. Fiberglass frames cost more but will last for 100 years.

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Efficient Windows *Collaborative*

<http://www.efficientwindows.org/factsheets.cfm>

Fact Sheet for Colorado

ENERGY STAR

[http://www.energystar.gov/index.cfm?c=windows\\_doors.pr\\_windows](http://www.energystar.gov/index.cfm?c=windows_doors.pr_windows)

Residential Windows

ENERGY STAR

[http://www.energystar.gov/ia/new\\_homes/features/HighPerformanceWindows1-17-01.pdf](http://www.energystar.gov/ia/new_homes/features/HighPerformanceWindows1-17-01.pdf)

Fact Sheet on High-Performance Windows