

Window Retrofit Options

Deciding What to Do With Existing Windows

Description

Windows play vital roles in our homes: bringing in natural light, connecting us visually with the outdoors, providing fresh air during warm months, helping to slow down heat loss, controlling unwanted temperature increases from sunlight (solar heat gain), and contributing to overall appearance. Balancing these attributes can be complex because some conflict with others; for example, a feature that optimally blocks unwanted summer heat gain may negatively affect views, daylighting, and beneficial solar heat gain in the winter.

Windows' impact on energy consumption is huge. In older homes, windows typically account for 25% of annual heating and cooling costs but can be responsible for as much as 40%. In new construction, a homeowner can easily minimize windows' energy impacts by choosing highly energy-efficient products.

But what should be done about existing windows?

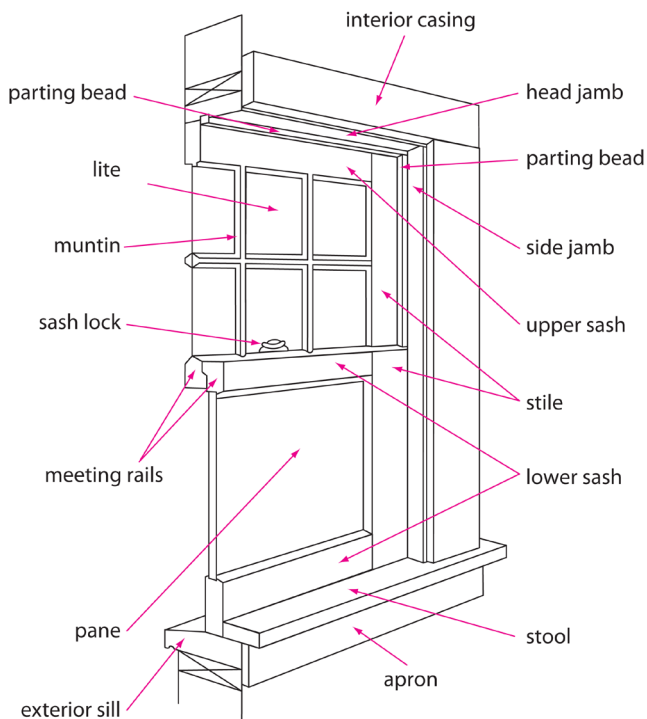
This fact sheet lays out a process for evaluating existing windows and deciding among a wide range of options for either replacing windows or retrofitting them with interior or exterior attachments, depending on the particular situation and needs.



Turning windows into walls is certainly the most extreme window retrofit, but it exemplifies this maxim: no window is perfect and we spend a lot of time and effort adjusting the performance of our windows with attachments. But which window retrofit option is the "best"? Read on.

Photo: Peter Yost

Names and Parts of a Typical Window



Rendering: BuildingGreen

Do Windows Need to Be Replaced?

The first step in deciding how to address existing windows in a home is to evaluate their condition. If the windows are in poor shape, the best course of action may be to replace them with new high-performance windows. The difference in price between standard and "high-performance" replacement windows with low-emissivity (low-e) coatings and gas fill will, in most cases, be quickly paid back through energy savings. In colder climates, triple-glazed replacement windows with two low-e coatings may be justified.

Windows are Good Candidates for Replacement if:

- Wooden frames are rotted or decayed.
- Windows are extremely leaky and weatherstripping is not practical.
- Aluminum or vinyl sashes are broken, cracked, or out of square.
- Sliding or hinged sashes can no longer be operated because of failed tracks or mechanisms.
- Seals on insulated glass panels have failed, as evidenced by condensation or fogging between the panes of glass.
- Wooden frames and sashes are covered with lead paint that is subject to abrasion.

The *Efficient Windows Collaborative* is the best source for information on window replacement.

If windows are in good shape, it's often hard to justify the cost of replacement, and one or more of the window retrofit measures described in this series of U.S. Department of Energy (DOE) fact sheets may be a better investment. The other fact sheets in the Window Retrofit Options series recommend attachment options based on the assumption that the homeowner has decided to keep existing windows.

What are Window Retrofits?

Window retrofits are elements added to existing windows to improve energy performance, reduce glare, provide privacy, or enhance the appearance or comfort of a home. Window retrofits include: interior shades and drapes, plastic films applied directly to the glass, exterior shades, shutters, awnings, and storm windows.

Deciding Among Various Window Retrofit Options

In considering the various options for window retrofits, it is important to understand how these treatments can affect window properties and performance. The attributes described below are keyed to a summary table at the end of this fact sheet.

Thermal Performance and Ventilation

Insulation

The degree of insulation a window provides is a major determinant of the window's overall thermal performance. Window retrofits can boost window insulation by adding layers of glazing, coatings that reduce radiant heat loss, and even moveable insulation panels.

Air tightness

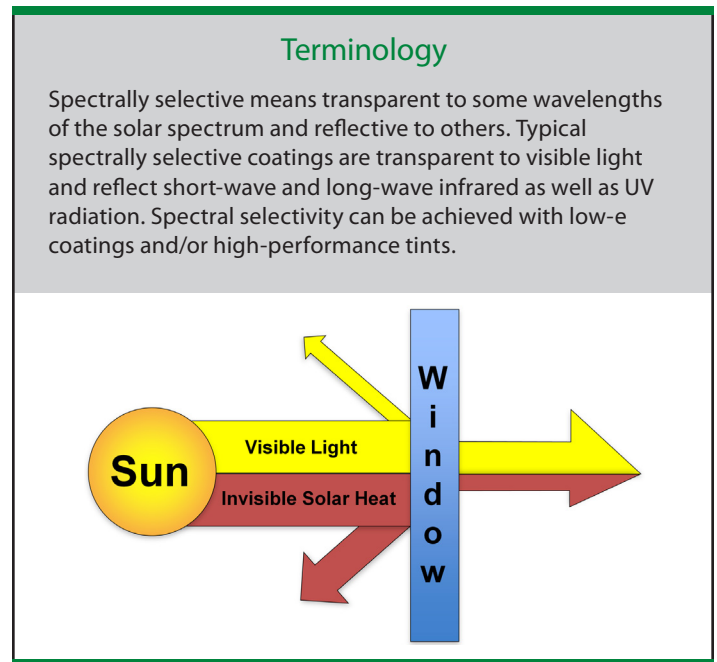
Air leakage through windows is another major determinant of overall window thermal performance, particularly in cold climates. Some window attachments improve airtightness by reducing air leakage.

Solar heat gain

Many window retrofits add significant solar heat gain control; they can be selected and adjusted depending on whether heat gain is desired or not.

Comfort – Winter

The thermal comfort provided by windows is a function of air leakage, surface temperature, and solar heat gain. During cold weather, some window retrofits improve



Graphic: LBNL

comfort by reducing air leakage and keeping the window surface facing the room warmer.

Comfort – Summer

During hot weather, some window retrofits improve comfort by controlling solar heat gain and keeping the innermost window surface cooler. Spectrally-selective glazing or coatings can improve the insulation, winter thermal comfort, and summer thermal comfort performance of many window retrofit options.

Condensation

When warm indoor air comes in contact with cold window surfaces, condensation can result. Window retrofits can prevent or reduce condensation by keeping the window's interior surface warmer. However, some window retrofits can increase condensation problems by either decreasing the temperature of surfaces that are in contact with warm, moist interior air, or by making the home more airtight and reducing the amount of dry, outdoor winter air leaking into the home.

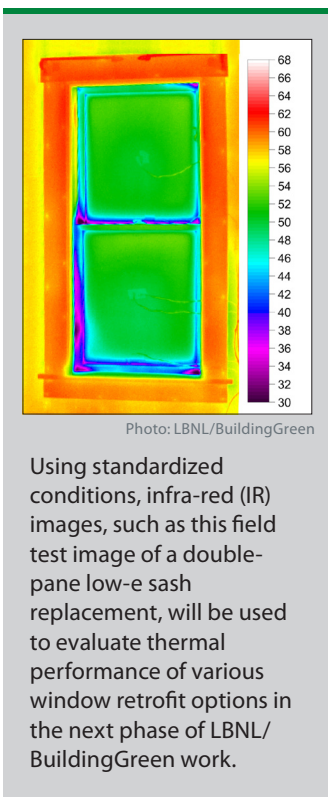
Ventilation

Some window retrofits, such as low-e storm windows with integral screens, facilitate the use of windows for ventilation; other retrofits can impede airflow through otherwise operable windows.

Visual performance

View

Home occupants may perceive the view from a window as essential or unwanted, depending on what is outside the window. Window retrofits can affect view temporarily or permanently. For example, window coverings such as shades and drapes can adjust to allow or block view while retrofits such as fixed awnings may always block a portion of the view.



Daylighting

Windows provide natural lighting during the day, and some window retrofits can increase or decrease daylighting. Any attachment that shades a window will reduce daylighting, whereas devices that redirect light, such as venetian blinds, can help to extend daylight deeper into a room.

Glare

Operable attachments, such as interior blinds and drapes, allow occupants to control glare. Exterior awnings control glare by shading windows. Applied films permanently reduce glare by tinting the glass.

Privacy

Windows not only provide views to the outdoors but also provide views into a house from outside, which may not always be desirable. Operable window retrofits, such as blinds and drapes, offer excellent privacy on demand.

Economics

Product cost

Product cost can range from as little as \$15 per window for a single-attribute attachment to as much as \$500 per window for a sensor-driven, motorized attachment that addresses several aspects of the window's overall performance.



Getting the best performance from your windows may involve both an interior and an exterior attachment. Note the interior shades and exterior awning serving this set of windows.

Photo: GlenRaven

increase thermal stress by trapping heat between layers of glass or between glass and an insulated interior window treatment.

Noise control

Some window retrofits can help to control noise, an important attribute for a home on a busy city street, for example. However, noise reduction is highly dependent on the airtightness of the window and any attachment.

Egress

Using windows as emergency exits can be desirable or essential. Some window attachments make exiting very difficult, others may pose a minor inconvenience, and others have no impact on egress.

Security

Retrofits such as applied window films can make it much harder to break into a house, and rugged exterior roller blinds often provide security as a primary function.

A Survey of Window Retrofits

The chart on page 4 lists the major types of window retrofits and rates them for the attributes described above (Note table legend at upper left). One way to use the summary chart is to choose the feature (column) you think is most important, and look down the column to see which types of retrofits (rows) are rated best for this feature.

For example, if you choose the first column, insulation, you can easily pick out the retrofits that have the highest rating (darkened circle). You can then compare the products that have the highest rating for this feature to the most highly rated products for another feature of importance. For example, roller shutters are highly rated for both insulation and security.

Installation cost

For window retrofits that must be professionally installed, quoted prices usually include installation. Other options offer significant savings for do-it-yourselfers.

Durability and service life

How long a window attachment lasts affects its total (life-cycle) cost. Warranties can be a proxy for durability, particularly if the warranty is for a specific number of years rather than "lifetime" (unless the lifetime warranty is transferable). Reparability is an important element of service life for operable attachments and motorized components.

The National Fenestration Rating Council (NFRC) is working on rating the performance properties of a wide range of window attachments.

Other uses and functions

Adjustability

There are a lot different ways to adjust window attachments: raising and lowering blinds; tilting louvers; opening and closing sashes. In all cases, adjustability is both a feature and a responsibility; optimal performance demands operation.

Window protection

Some window retrofits protect windows from the elements (wind, rain, and ultraviolet radiation). Other measures can

Retrofit Option	Thermal						Visual				Economics			Other					
	Insulation	Airtightness	Solar Heat Control	Winter Comfort	Summer Comfort	Condensation Resistance	Ventilation	Maintains View	Daylighting	Glare Control	Privacy	Low Product Cost	Low Installation Cost ⁹	Durability/Service Life ¹⁰	Adjustability	Protection for Window	Noise Control	Egress	Security
LEGEND	<ul style="list-style-type: none"> "Greatest benefit" "Moderate benefit" "Neutral or average" "Potential detriment or weak point" 																		
Exterior Attachments																			
Low-e storms windows																			
Awnings																			
Roller shades																			
Roller shutters																			
Interior Attachments																			
Conventional roller shades																			
Conventional drapes																			
Louvered blinds																			
Fixed window panels																			
Insulated cellular shades ⁸																			
Window quilts																			
Surface-applied films																			
Other																			
Existing window rehab																			
Solar Screens																			
Seasonal single-use film kits																			

General Notes:

- Cell values often do not do justice to the *range* of product performance; see individual fact sheets for more detailed information.
- Values for adjustable attachments assume that they are optimally deployed for their strongest performance feature.

Footnotes:

1. Current low-e, *high* solar heat gain exterior storm windows and interior window panels will soon be joined by low-e, *low* solar heat gain options.
2. Fixed awnings may partially block view.
3. Fixed awnings are much less expensive than motorized retractable awnings.
4. Assumes awning is retractable.

5. Assumes drape with light-colored exterior.
6. Low-e glass and double-layer plastic panels have greatest insulation benefits.
7. Plastic fixed panels are the most affordable.
8. Assumes cellular shade is top-down/bottom-up type.
9. Many attachments can be DIY installations; only full solid circles assume DIY in this table.
10. Assumes that warranty serves as a proxy for service life/durability and that the individual values mean that a warranty corresponding to the value is available for that window attachment.

For more information visit: www.windowattachments.org