

## Summer Shading and Exterior Insulation for North Carolina Windows

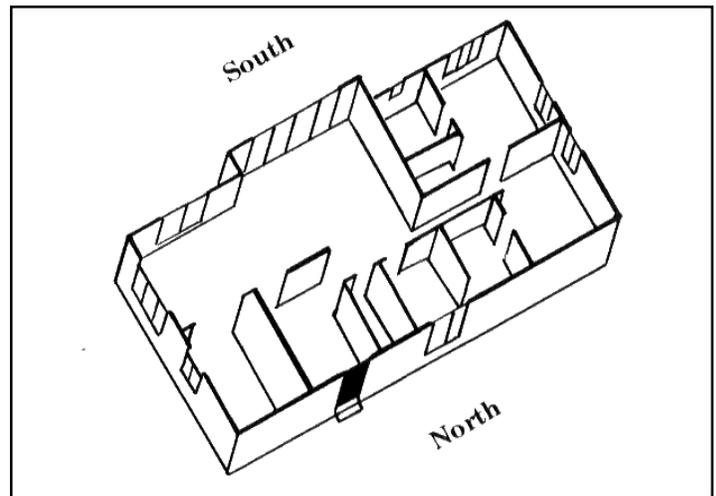
The same windows that provide a view, natural lighting, and ventilation at home may be adding to your winter heating and summer cooling costs. This is especially true if you've insulated and weatherized your house but neglected improving window energy efficiency. A well-insulated window will never be as efficient as a well-insulated wall, but you can upgrade the energy performance of that window in various ways.

You'll need to analyze the orientation of windows in your house, their condition, how easy they are to get to, and the cost and availability of products before you make improvements. Another consideration is the seasonal aspect of many products. Some window treatments may stop summer heat gain, but do little to reduce heat loss through the window in winter. You may have to combine or alternate window products to get the best effect.

### Window Orientation

The direction the window faces, in addition to the size, affects its energy gain or loss. Generally speaking, windows on the south side of your house will always be net energy gainers in the winter. That is, they gain enough radiation during the day to offset heat losses through the same windows at night. Because the sun's path changes seasonally, properly sized roof overhangs above south windows will keep out direct summer sun but still let in winter sunlight to warm rooms.

Windows on the north side of the house are usually net energy losers. They don't gain enough direct solar radiation during the day to offset nighttime heat losses.



*Figure 1. Orientation is a major factor in choosing window insulation and shading. South windows are best for winter solar gain and can be shaded by the roof overhang. East and west windows can cause overheating in the summer and need seasonal shading. Keep north windows to a minimum and insulate in the winter.*

Windows on the east and west sides of the house can add unwanted summer heat gains. On the west side, it's difficult to design an overhang deep enough to block the late-afternoon sun, so you may have to use awnings, shutters, window films or screens.

In winter, the most heat gain benefit is from south-facing windows. North windows, regardless of size, should receive first attention for wintertime insulation. In summer, the most heat gain which may cause cooling problems is from east and west windows. Consider appropriate shading of east-west areas first.

If you're building a new home or remodeling, try to have the major windows face south, with few east, west,

<b>Window Checklist</b>					
<b>Orientation (N,S,E,W) of Window</b>	<b>Size of Window Glass (sq. feet or sq. inches)</b>	<b>Number of Layers of Glass (1,2,3,etc.)</b>	<b>Has Storm Panel</b>	<b>Needs Weather- stripping</b>	<b>Needs Caulking</b>

or north windows. If your windows can't be changed, determine the orientation of each window and choose options to control seasonal heat loss and heat gain.

### **First Things First**

Be sure the windows in your home are in good condition and weathertight. Repair or replace broken or cracked windows. Older windows may need weatherstripping to reduce infiltration losses. Check to see which windows need to be caulked around the outside edge of the window frame. If your windows have been caulked, note the condition of the caulk. Cracked or missing strips mean recaulking is needed. There are many excellent how-to-do-it publications on caulking and weatherstripping available from such sources as your County Extension office, utility companies, home improvement centers, the public library, and the Solar Center.

As you inspect your windows, note their size, orientation and layers of glass. Are your windows made of single or double-pane glass? Do you have storm panels on the outside or inside of single pane windows? It may be helpful to make a checklist, like above, to use for your window inventory.

### **Decisions About What to Choose**

Before you select a seasonal window product you'll need to consider other factors than just window orientation. How easily installed is the product? Can you do it yourself, or should it be commercially installed? Will you like the way it looks when it's in place? Will it interfere with normal window operation, or be a problem in emergencies? Will the product be fixed-in-place, or will you have to open, close or adjust it to get the best effect? Do you have a place to store it, if it's removed seasonally? What is its insulation or shading value? How long can you expect it to last? What is its cost, compared with other products? What is its warranty or guarantee?

### **Comparing Exterior and Interior Products**

Most window energy products on the market are for inside use. They may be used with an existing window treatment or replace the window treatment altogether.

Exterior products have advantages and disadvantages. In areas like North Carolina, where summer cooling is a major concern, reducing solar gain is important. From a cooling standpoint, it makes sense to install heat-rejecting devices on the outside. That way, solar gain is kept from heating up the windows and the house.

But exterior products have to withstand the outside weather. They may not be the best choice on hard-to-reach windows unless they are mechanically operated. Some products, like solar screens, can be left on through the cooling season but need to be removed before the winter heating season. You'll need storage space for them. Other products, like awnings, may need to be opened or closed daily. They are only effective if used regularly and properly. Devices like exterior thermal shutters may have to be opened and closed from outside the house and require regular use to be effective. Costs vary widely and are comparable to interior products. Some products, like plastic interior storm panels, may cost as little as 50 cents a square foot. Exterior rolling shutters may cost up to \$20 a square foot.

Many exterior products, such as solar screens, window films and awnings, are excellent for shading but don't insulate well in cold weather. This factor, combined with operation, maintenance and storage requirements, may make interior movable insulation preferable. Interior insulation can be used with, or to replace, a traditional window treatment. Operated from inside the house it isn't exposed to weather.

You may want to consider a combination of interior and exterior products. For south-facing windows, a properly sized overhang may provide all the summer

shading needed to prevent overheating. Rather than add solar screens to these windows, a better investment might be movable interior insulation to reduce winter heat loss. North-facing windows that lose heat in winter would benefit more from interior movable insulation than exterior shading devices. East and west windows may require both exterior and interior treatments. Solar screens, awnings or window films effectively reduce summer solar gain, while interior movable insulation reduces winter heat loss.

## Exterior Window Options to Reduce Winter Heat Losses

To add insulation value to windows, consider storm panels, exterior thermal shutters and energy efficient replacement windows.

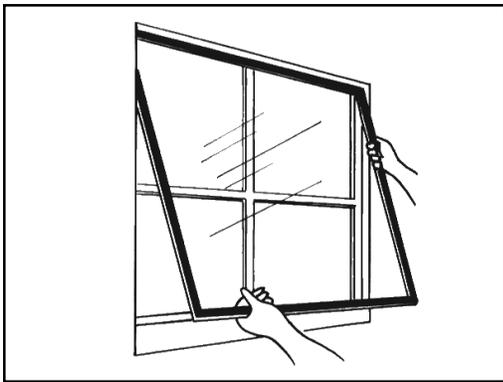


Figure 2. An interior storm panel is inexpensive and can be used with casement and awning windows that are difficult to fit with exterior storms.

### STORM PANELS

Storm panels added to single-pane windows can reduce heat transfer through the glass by half. For the homeowner with single-pane windows, storm panels serve the same purpose as double-pane replacement windows. They block heat transfer and are less expensive.

There are two major types of storm panels for exterior use: single and combination. A single storm window is made of glass, rigid plastic or plastic sheet. It has no movable panels and is usually taken down in the spring. A combination storm window consists of two window panes and a screen permanently fixed over the window. In summer, one of the glass panes slides up and the screen slides down for ventilation.

Storm panels that can be used on the inside of the window are also an option. They are gaining in use, because they usually cost less than exterior panels. These panels are made from kits available in home improvement stores, from building suppliers, or in discount and hardware stores. Some window suppliers now offer custom-

made interior storm panels along with their more traditional exterior storm panels.

You can select a rigid plastic or acrylic or choose a flexible plastic for the glazing. Flexible glazings such as polyethylene plastic are less expensive but are usually not as clear and may wrinkle or sag after you install them. An exception is polyolefin heat-shrink film. Heat-shrink film doesn't wrinkle because the film actually shrinks tightly against the seal when it's heated with a hair dryer.

Interior storm panels are held in place with two-part seals. One part is attached to the window frame itself and stays up all year round. The other part holds the glazing to the window frame. Magnetic seals, Velcro seals and snap-in seals are commonly used with rigid glazing. Flexible glazing tends to be used with snap-in retainer seals or double-faced-tape.

For the most part, interior storm panels are seasonal window insulation. They go up before the heating season and come down before the cooling season. While their energy performance seems equal to that of exterior panels, the durability of their glazings and seals is not yet known.

Interior storm panels are useful for awnings, hopper and other crank-out windows, where it's difficult to use an exterior storm panel.

### EXTERIOR THERMAL SHUTTERS

Exterior thermal shutters have a core of insulation to reduce heat loss. They should fit tightly over the window when closed. A good edge seal reduces infiltration and minimizes condensation on the window.

They also provide additional security when closed and locked. Their primary disadvantage is that you must usually go outside to close them. They can provide a higher insulation value to the window than a storm panel but are somewhat less convenient. They are also less commercially available than either storm panels or interior movable insulation.

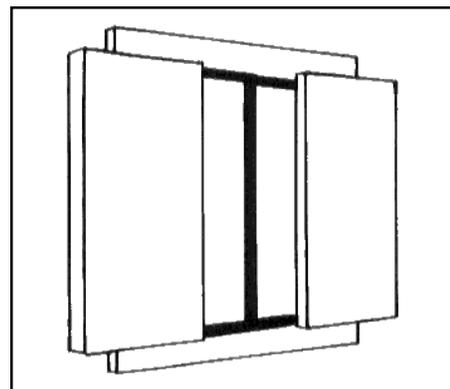


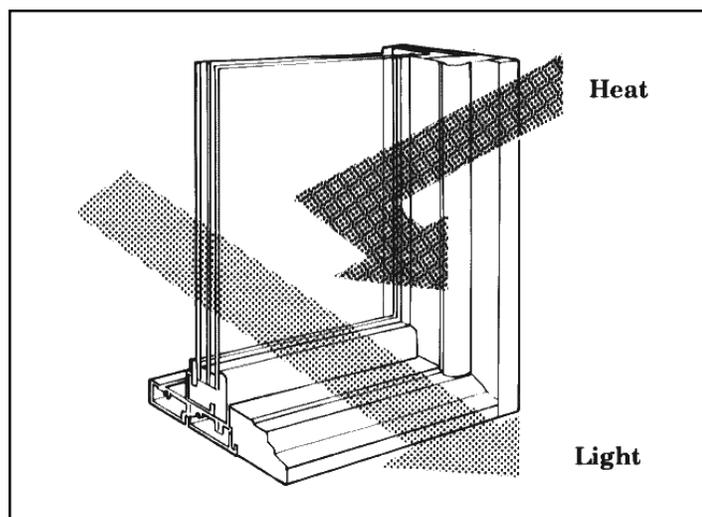
Figure 3. Exterior thermal shutters can be hinged or may slide. They should be weather-stripped for a tight edge seal.

## REPLACEMENT WINDOWS

If your windows have to be replaced, you may want to choose double-pane or insulating glass windows, rather than single-pane windows with a storm panel. Double-pane windows have panes of glass with an insulating air space or inert gas filler between the panes. The panes are sealed together at the factory. This prevents moisture from entering between the panes. They are also constructed to reduce air infiltration.

Recently, low emissivity or “low-e” windows have appeared on the market. These windows use a metallized coating to improve the window’s insulation value. Some manufacturers coat a thin film and suspend it between two layers of glass. Others coat the glass itself. Although products vary by manufacturer, in most cases the coating is so thin that the glass appears clear, not tinted.

The addition of a low-e film creates two important



*Figure 4. Low-emissivity or “low-e” windows use a metallized coating or film between two layers of glass. The film admits natural light but reflects heated or cooled air back inside the living space.*

changes in the properties of the window. First, it increases its R-value, which reduces the amount of heat lost or gained through the window. Second, it reduces its solar transmittance. For east and west windows where cooling is a primary concern, the resulting reduction in unwanted heat gain and fading of upholstery is beneficial, but it may not be a desirable feature in south-facing windows intended for solar heating.

Cost for low-e windows are somewhat higher than those of conventional windows, but prices are expected to drop as more manufacturers begin to produce them. It should be stressed that although the use of quality win-

dows is important, the quality of the workmanship in their installation is equally important. Even the best window will perform poorly if the opening is not fitted properly or caulked.

## Exterior Window Options to Reduce Summer Heat Gain

Shading windows is one solution for reducing summer cooling costs. Except for fixed roof overhangs, most shading devices should be taken off windows as winter approaches.

Shading can be interior or exterior, but exterior shading is about twice as effective as interior shading.

The most effective shading options are awnings, movable louvers, or shutters, and natural vegetation like trees and vines. Next in effectiveness are tinted or reflective films, solar screens and exterior rolling shades. Finally, interior roller shades, venetian blinds, and draperies can provide some shading. Since they let sunlight strike and heat the window surface, they are the least effective shading options.

Shading is most effective outside the window. A shaded window which allows air circulation between the shading device and the glass will greatly reduce solar heat gain.

## ROOF OVERHANGS

Roof overhang is one of the most effective forms of exterior shading for south-facing glass. It is easily incorporated in the design when the house is under construction. Correction or addition of a roof overhang on an existing home is difficult and sometimes impossible. However, louvered patio covers or lattice-type panels are feasible and effective on many southern exposures.

## AWNINGS

Awnings reduce summer solar heat gain up to 65% on south-facing windows and 77% on west-facing windows, according to the National Bureau of Standards. Awnings offer shading flexibility. They can shade an individual window or be custom-made to shade the entire side of a house. They offer a means of controlling light and reducing glare.

Awnings have traditionally been made of metal or canvas, which may need to be re-covered every five to seven years. A new generation of awnings is being made from synthetics like acrylic and polyvinyl laminates. Awning fabrics are treated to resist mildew and fading, and to be water-repellent. Whatever the fabric, it should be tightly woven, opaque to keep light from passing through,

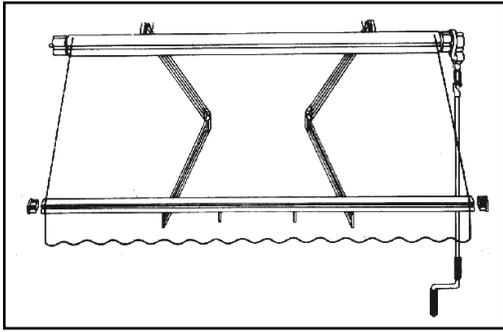


Figure 5. Lateral arm awnings make adjusting, opening and closing easy. But an awning with lateral arm hardware will be considerably more expensive.

and light in color. Lighter colors reflect more sunlight.

Adjustable or retractable awnings can be rolled up and left in place in the winter, letting in sunlight to warm the house. New hardware, such as lateral arms, make operation of the awning quite easy.

The awning should have a means of allowing ventilation to keep hot air from being trapped around the window. Sometimes this ventilation is provided by grom-

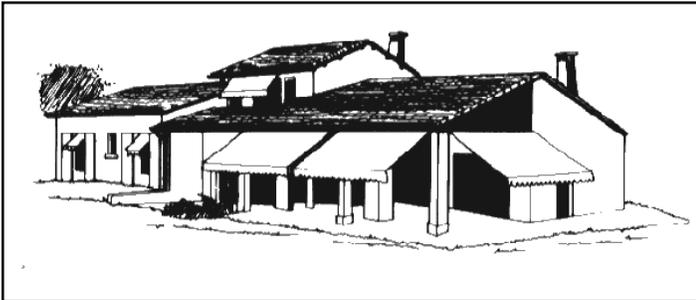


Figure 6. Awnings should be light-colored for most effective shading. Sideless awnings can shade east-west windows effectively. For south windows, an awning with sides may give better shading against angled sunlight.

mets or openings along the sides and top of the awning. Or, the awning may be open to the sides or at the top to vent heated air away from the window.

Sideless awnings can be adjusted as the angle of sunlight changes. Since direct sunlight may be able to enter the house when a sideless awning is used, this type awning may not be as effective on south-facing windows.

For the most effective awning, consider the specific orientation of the window. For instance, a south-facing window needs only a small horizontal awning to be completely shaded all summer, all day. An east- or west-facing window needs an awning that extends down a substantial percentage of the window height to provide shade from early morning or late afternoon sun.

## EXTERIOR SHUTTERS

Louvered shutters block direct sunlight and reduce solar heat gain by 80% when used properly, according to the National Bureau of Standards.

Light-colored shutters will be most effective, because they reflect, rather than absorb, much of the sunlight. Louvers also allow natural ventilation.

Variations on the shutter include the Bahama shutter, which is especially useful on second-story windows. This shutter is hinged at the top and projects out from the window at an angle. It is held in place by a rod or wooden strip. Because of its angled position, it acts somewhat like an awning in shading the window.

Louvered panels or screens can be used in place of shutters when feasible. The panels can be mounted above the window, as is the case at the North Carolina State University Solar Demonstration House. The panels are dropped in place during the summer months and removed from the supporting frame before winter. Panels can also be placed in front of the window to provide shading and privacy.

## NATURAL VEGETATION

Trees, shrubs and vines offer some of the best exterior shading available. A deciduous tree or vine shades a home from the summer sun, and then, when the leaves fall, allow winter sunlight inside the house. They are most effective when planted on the south, east and west sides. Evergreens provide shade and offer protection from the wind on the north side.

Shrubs planted near the vertical surface of unshaded walls can also reduce summer solar gain. Vines and wall covers, such as ivy, can reduce heat gain but should be placed on a trellis 3 to 4 inches from the wall. Otherwise moisture may cause damage to the house.

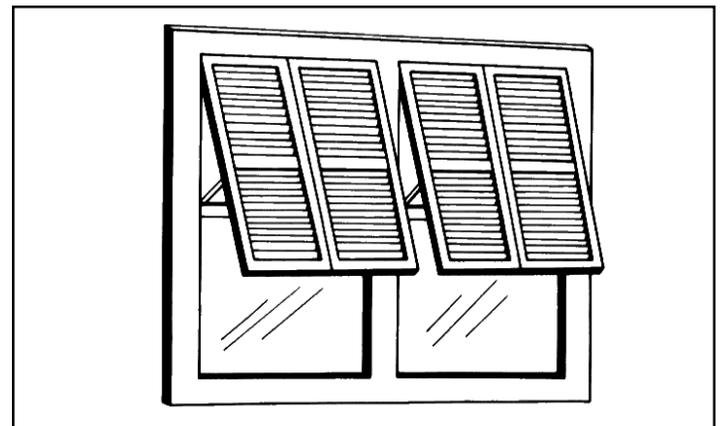


Figure 7. The Bahama shutter combines natural ventilation with awning-like shading.

## FILMS

Tinted or reflective films are usually attached to the inside of the window. They are generally not strong enough to resist exposure to weather. Films are sometimes advertised as “sun-control” or “combination” types. Sun-control films are for seasonal use and keep out solar gain and glare. Combination films have a heat-reflecting property as well as sun-control characteristics. They are considered to be permanent installations. The heat-reflecting coating is designed to keep winter heat from escaping through the window, while the sun-control features keep out unwanted summer heat.

When selecting a window film, look for three manufacturer’s specifications:

- the R-value, or insulating value;
- the shading coefficient, or percentage of solar gain it admits (the lower the coefficient, the less solar gain it transmits);
- the percentage of visible light transmitted (the higher the percentage, the more light it admits).

If the film is to be used for shading or keeping out heat, you should choose a film with a low shading coefficient. A film that is rated with a shading coefficient of .20 will keep about 80% of the sunlight out of the house.

If the film is to be used to reduce glare, look for a film that has a low rating for visible light transmittance. If you want to control both shading and glare, look for a film that has the lowest combination of the two ratings.

Sun-control films seem to be most effective on east and west windows. If this type of film is left permanently on a south-facing window, it will block out the winter-heat gain that is desired from these windows.

Combination films should not be used on sealed, insulated (or double-pane) type windows. Because heat can cause uneven expansion of the glass, it can cause the insulating seal to break. Sometimes the glass can break, too. Check the film you’re considering to see if it’s recommended for use on such type windows.

Since a smooth, uniform application of the film is desirable, you may want to have it commercially installed, especially on large windows.

## SOLAR SCREENS

Solar screens are more effective than regular screens in reducing solar heat gain through windows. These screens, similar to conventional window screens, are

available in two types. One is a metal screen made up of tiny, angled fins. Its manufacturers claim that it can reflect 60% to 80% of the sun’s heat and glare while still admitting some visible light.

The other type, made of coated fiberglass mesh, is non-reflective. It blocks sunlight but absorbs some of the sun’s energy and turns it into heat. The heat, however, is dissipated outside the window. The fiberglass mesh screens may block 70% to 80% of the sun’s heat. These screens can be ordered to size for particular windows, or the mesh can be bought by the roll (or portion of roll) and made by the homeowner. The screening material is held in place by special hardware that snaps in the window frame. This keeps the screen tightly in place, and lets you remove it at the end of the summer.

Solar screens have the advantage of allowing natural ventilation into the house. They are as effective with the window opened as closed. They are a good option for west windows that get late afternoon sun.



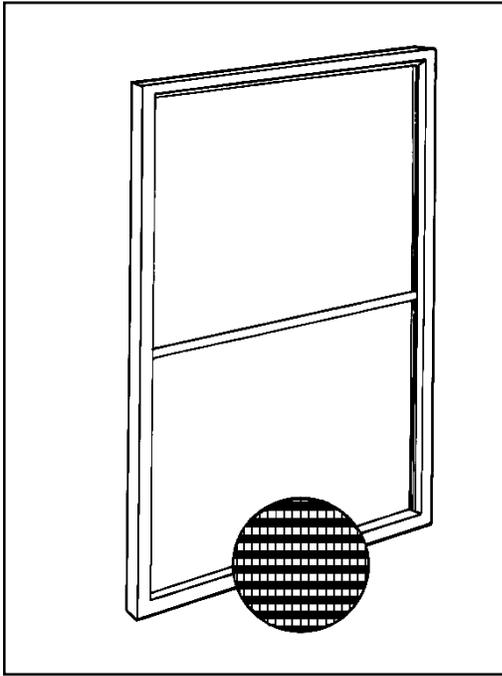
*Figure 8. Vines on a trellis can provide effective summer shading. Keep them several inches away from the house to avoid moisture build-up.*

## EXTERIOR ROLLING SHADES

Exterior rolling shades and shutters can also provide summer shading. The simplest types are inexpensive bamboo shades, widely available at department and discount stores. They must be operated manually and usually need to be replaced every few years.

More permanent (and more expensive) exterior rolling shutters combine shading, ventilation and security features. These shutters have horizontal slats (usually made of aluminum or polyvinyl chloride-PVC), guide rails, a housing unit to hold the shutters when rolled up, and manual or automatic controls.

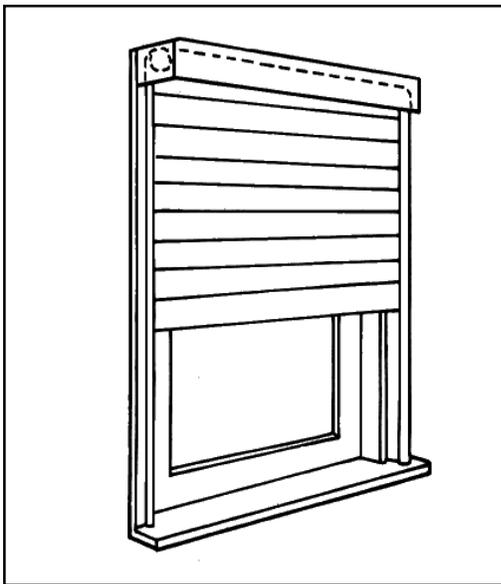
The slats are sometimes filled with an insulating material. Research indicates that their insulating value is far



*Figure 9. Solar screens made of fiberglass mesh can block 70 to 80 percent of the sun's heat. This seasonal shading should be removed before the heating season.*

less than other window insulation products. They should be mainly considered for their shading ability. Slat sizes range from 1 1/4 inches to 2 inches in size, depending on the size of the housing and the width of the window to be covered.

The guide rails provide structural support and fasten to the window. The housing unit is mounted above the



*Figure 10. The exterior rolling shutter shades the window and offers maximum security when rolled down.*

window, on the outside, and stores the shutter when it's raised. Controls can be manual, such as a strap and cord or hand-cranked. Electric-driven automatic controls are also available for exterior rolling shutters.

Most of the shutters are slotted so that air can circulate into the house even when the shutter is fully extended.

## Summary

Remember to analyze your window orientation before you make any decision about exterior shading or insulating devices. Check with window suppliers, building product suppliers and companies that specialize in energy conservation products to compare what's available in your area and the cost of products. The type of product you select may also be based on how easy it is to use, remove and store. Make sure that your windows are well-weatherized before you add any shading and insulating devices.

## References

The following publications provide further information on improving the energy performance of windows. This list is not exhaustive; inclusion does not imply endorsement by the North Carolina Solar Center, nor does omission of similar materials imply criticism.

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## For More Information

The North Carolina Solar Center has a reference library as well as other free factsheets and information on renewable energy, energy efficiency, and related subjects. For more information on these topics, or to learn more about the resources available at the Solar Center.

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