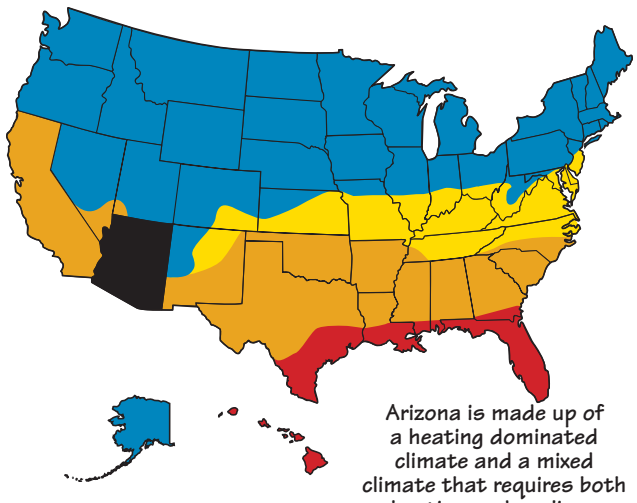
Efficient Windows Collaborative

Fact Sheet: Selecting Energy Efficient Windows in Arizona

www.efficientwindows.org September 2004



Benefits of High Performance Windows

Cooling and Heating Season Savings
Low-E coatings, gas-fills, and insulating spacers and frames can significantly reduce winter heat loss and summer heat gain.

Improved Daylight and View
New glazings with low-solar-gain low-E coatings can reduce solar heat gain significantly with a minimal loss of visible light (compared to older tints and films).

Improved Comfort
In summer and winter occupant comfort is increased; window temperatures are more moderate and there are fewer cold drafts. Discomfort from strong summer sunlight is reduced.

Reduced Condensation
Frame and glazing materials that resist heat conduction do not become cold and this results in less condensation.

Reduced Fading
Coatings on glass or plastic films within the window assembly can significantly reduce the ultraviolet (UV) and other solar radiation which causes fading of fabrics and furnishings.

Lower Mechanical Equipment Costs
Using windows that significantly reduce solar heat gain means that cooling equipment costs may be reduced.

Visit www.efficientwindows.org for more information on the benefits of efficient windows, how windows work, how to select an efficient window, and what manufacturers provide efficient windows.

1. Look for the Energy Star®

The Department of Energy (DOE) and the Environmental Protection Agency (EPA) have developed an Energy Star (www.energystar.gov) designation for products meeting certain energy performance criteria. Since performance of windows and skylights vary by climate, product recommendations are given for the four Energy Star climate zones. To distinguish between Energy Star products, go to Step 2.

2. Look for Efficient Window Properties on the NFRC Label

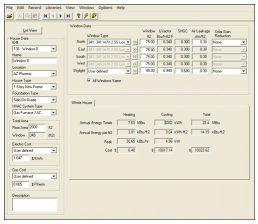
The National Fenestration Rating Council NFRC (www.nfrc.org) has developed a window rating system based on whole window product performance. The NFRC label provides the only reliable way to determine the energy efficient properties and to compare products. The NFRC label appears on all fenestration products which are part of the Energy Star program. See Page 2 for the recommended properties for this climate. For typical cost savings from efficient windows in a specific location, go to Step 3.

3. Compare Annual Energy Costs for a Typical House

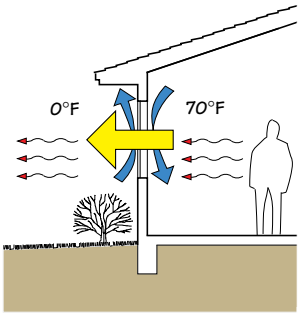
Computer simulations for a typical 2000 square-foot house are used to compare the annual energy performance of different window types. A comparison of the energy performance of a set of windows for this climate begins on Page 3.

4. Customize Energy Use Calculations for a Specific House

A computer simulation program, such as RESFEN (windows.lbl.gov/software/resfen), lets you compare window options by customizing calculations by adding heating and cooling costs for your climate, house design options, and utility rates.

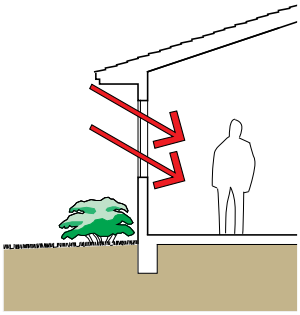


Look for Efficient Window Properties on the NFRC Label



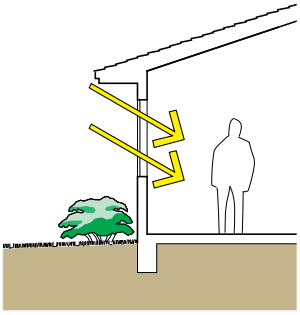
U-Factor

The rate of heat loss is indicated in terms of the U-factor (U-value) of a window assembly. The insulating value is indicated by the R-value which is the inverse of the U-value. The lower the U-factor, the greater a window's resistance to heat flow and the better its insulating value. U=U-factor in Btu/hr-sf-°F.



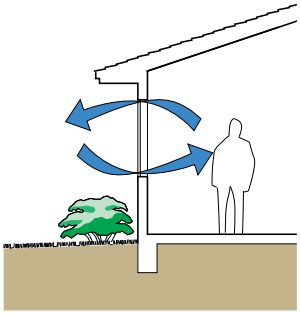
Solar Heat Gain Coefficient (SHGC)

The SHGC is the fraction of incident solar radiation admitted through a window. SHGC is expressed as a number between 0 and 1. The lower a window's solar heat gain coefficient, the less solar heat it transmits. Use a computer program such as RESFEN to understand heating and cooling trade-offs. SHGC=Solar Heat Gain Coefficient in fraction of incident solar angle.



Visible Transmittance (VT)

The visible transmittance (VT) is an optical property that indicates the amount of visible light transmitted. The NFRC's VT is a whole window rating and includes the impact of the frame which does not transmit any visible light. While VT theoretically varies between 0 and 1, most values are between 0.3 and 0.8. The higher the VT, the more light is transmitted. A high VT is desirable to maximize daylight. VT=Visible Transmittance in fraction of incident visible radiation.



Air Leakage (AL)

Heat loss and gain occur by infiltration through cracks in the window assembly. Air leakage is expressed in cubic feet of air passing through a square foot of window area. The lower the AL, the less air will pass through cracks in the assembly. While many think that AL is extremely important, it is not as important as U-factor and SHGC. AL=Air Leakage in cfm/sf.

Northern Climate Zone (mostly heating)
South/Central Climate Zone (heating & cooling)

Recommended Properties in the Northern Zone (mostly heating)

U-factor	Solar Heat Gain Coefficient (SHGC)	Visible Transmittance (VT)	Air Leakage (AL)
Windows: U≤0.35 **Skylights: U≤0.60*** Note: If air conditioning loads are minimal, windows with U-factors as high as 0.40 are also energy-efficient if the Solar Heat Gain Coefficient is 0.50 or higher.	No requirement. Note: To reduce heating, select the highest SHGC you can find (usually 0.30-0.60 for the U-factor ranges required in colder climates) so that winter solar gains can offset a portion of the heating energy need. If cooling is a significant concern, select windows with a SHGC less than 0.55. Select skylights with a SHGC of 0.55 or less.	No requirement. Note: Select windows with a higher VT to maximize daylight and view.	No requirement. Note: Select windows with an AL of 0.30 or less.

Recommended Properties in the South/Central Zone (heating and cooling)

U-factor	Solar Heat Gain Coefficient (SHGC)	Visible Transmittance (VT)	Air Leakage (AL)
Windows: U≤0.40 **Skylights: U≤0.60*** Note: The larger your heating bill, the more important a low U-factor becomes.	**Windows: SHGC≤0.40** **Skylights: SHGC≤0.40** Note: If you have moderate air conditioning requirements, select windows with a SHGC of 0.55 or less. While windows with lower SHGC values reduce summer cooling and overheating, they also reduce free winter solar heat gain.	No requirement. Note: Select windows with a higher VT to maximize daylight and view.	No requirement. Note: Select windows with an AL of 0.30 or less.

* U-factor qualification criteria based on 2001 NFRC simulation and certification procedures that rate skylights at a 20-degree angle. For more information, see www.energystar.gov.

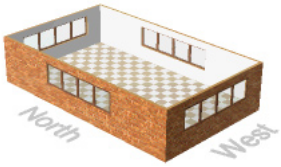
Efficient Windows Collaborative
This fact sheet was produced with funding from the Windows and Glazings Program at the U.S. Department of Energy (www.eren.doe.gov) in support of the EWC. For more information, contact:

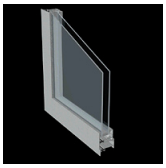
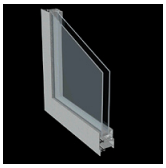
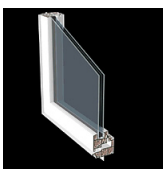
EWC/Alliance to Save Energy
1200 18th Street NW, Suite 900
Washington, D.C. 20036
phone 202-857-0666
fax: 202-331-9588
www.ase.org
www.efficientwindows.org

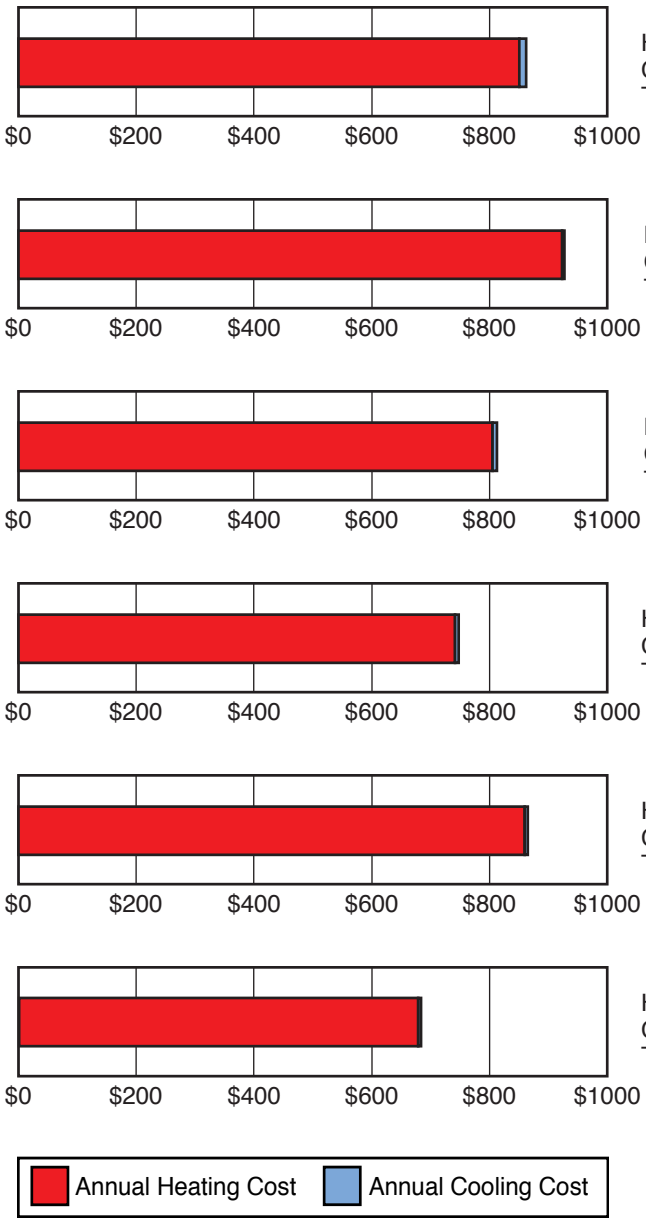
Residential Windows Book
Carmody, J., S. Selkowitz, D. Arasteh, and L. Heschong. Residential Windows: New Technologies and Energy Performance, 2nd ed. New York, NY: W.W. Norton & Company, 2000.

Comparing Window Performance in Flagstaff, Arizona

The annual energy performance figures shown here were generated using RESFEN for a typical, new 2000 sq. ft. house with 300 sq. ft. of window area (15% of floor area). The windows are equally distributed on all four sides of the house and include typical shading (interior shades, overhangs, trees and neighboring buildings). *



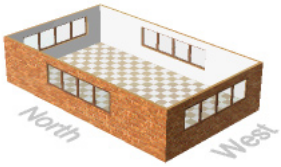
Case Studies	Properties	Annual Energy Use	Costs
 **CASE 1** double glazing clear glass aluminum frame w/ thermal break	U = 0.63 SHGC = 0.62 VT = 0.62		Heating $857.89 Cooling $5.47 Total $863.36
 **CASE 2** double glazing low-E coating (low solar gain) argon gas fill aluminum frame w/ thermal break	U = 0.47 SHGC = 0.33 VT = 0.53		Heating $935.01 Cooling $0.74 Total $935.75
 **CASE 3** double glazing clear glass vinyl/wood frame	U = 0.49 SHGC = 0.56 VT = 0.58		Heating $808.69 Cooling $4.39 Total $813.08
 **CASE 4** double glazing low-E coating (high solar gain) argon gas fill vinyl/wood frame	U = 0.37 SHGC = 0.53 VT = 0.53		Heating $748.78 Cooling $4.07 Total $752.85
 **CASE 5** double glazing low-E coating (low solar gain) argon gas fill vinyl/wood frame	U = 0.34 SHGC = 0.30 VT = 0.50		Heating $866.78 Cooling $0.55 Total $867.33
 **CASE 6** triple glazing low-E coating (mod. solar gain) argon gas fill insulated vinyl frame	U = 0.18 SHGC = 0.40 VT = 0.49		Heating $687.84 Cooling $1.93 Total $689.77

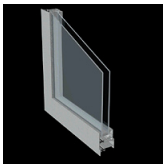
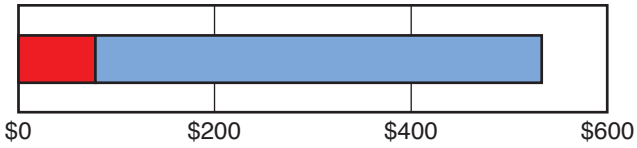
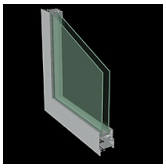
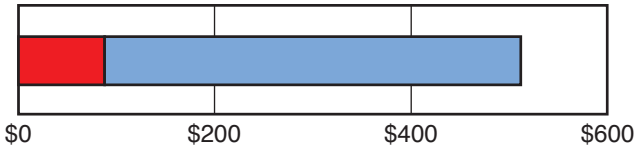
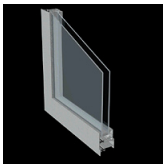
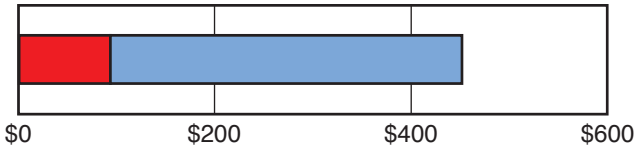
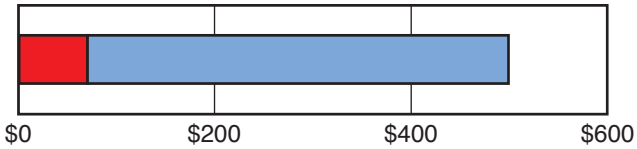
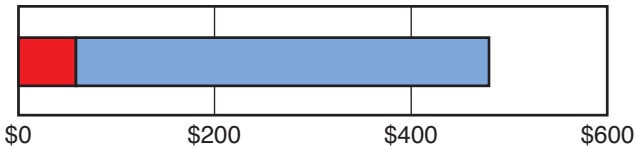
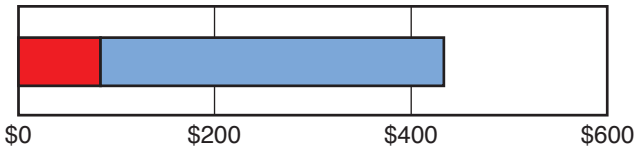


*Note: U-factor, SHGC, and VT are for the total window including frame. Energy use and savings between different window options will usually be higher for homes which are not as well insulated as typical new homes. The c
for lights, appliances, hot water, cooking, and other uses are not included in these figures. The mechanical system uses a gas furnace for heating and air conditioning for cooling. These figures are based on year 2003 average energy costs for this region (natural gas, $1.139/therm and electricity, $0.074/kWh). Natural gas prices are from U.S. Natural Gas Summary (tonto.eia.doe.gov/dnav/ng/ng_sum_lsum_dcu_nus_a.htm), and the electric prices are from Table 5.6.B: Average Retail Price of Electricity to Ultimate Customers (www.eia.doe.gov/cneaf/electricity/epm/table5_6_b.html). These tables are provided by the Energy Information Administration (www.eia.doe.gov). RESFEN is computer program for calculating the annu
(windows.lbl.gov/software/resfen).

Comparing Window Performance in Phoenix, Arizona

The annual energy performance figures shown here were generated using RESFEN for a typical, new 2000 sq. ft. house with 300 sq. ft. of window area (15% of floor area). The windows are equally distributed on all four sides of the house and include typical shading (interior shades, overhangs, trees and neighboring buildings). *



Case Studies	Properties	Annual Energy Use	Costs
 **CASE 1** double glazing clear glass aluminum frame w/ thermal break	U = 0.63 SHGC = 0.62 VT = 0.62		Heating $79.73 Cooling $457.17 Total $536.90
 **CASE 2** double glazing tinted glass aluminum frame w/ thermal break	U = 0.63 SHGC = 0.52 VT = 0.47		Heating $88.50 Cooling $427.80 Total $516.30
 **CASE 3** double glazing low-E coating (low solar gain) argon gas fill aluminum frame w/ thermal break	U = 0.47 SHGC = 0.33 VT = 0.53		Heating $93.06 Cooling $366.36 Total $459.42
 **CASE 4** double glazing clear glass vinyl/wood frame	U = 0.49 SHGC = 0.56 VT = 0.58		Heating $71.87 Cooling $434.51 Total $506.38
 **CASE 5** double glazing low-E coating (high solar gain) argon gas fill vinyl/wood frame	U = 0.37 SHGC = 0.53 VT = 0.53		Heating $62.87 Cooling $420.81 Total $483.68
 **CASE 6** double glazing low-E coating (low solar gain) argon gas fill vinyl/wood frame	U = 0.34 SHGC = 0.30 VT = 0.50		Heating $81.67 Cooling $352.36 Total $434.03

*Note: U-factor, SHGC, and VT are for the total window including frame. Energy use and savings between different window options will usually be higher for homes which are not as well insulated as typical new homes. The c
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Comparing Window Performance in Tucson, Arizona

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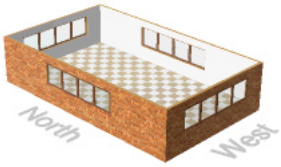

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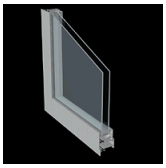
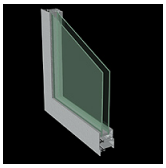
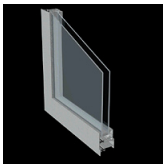
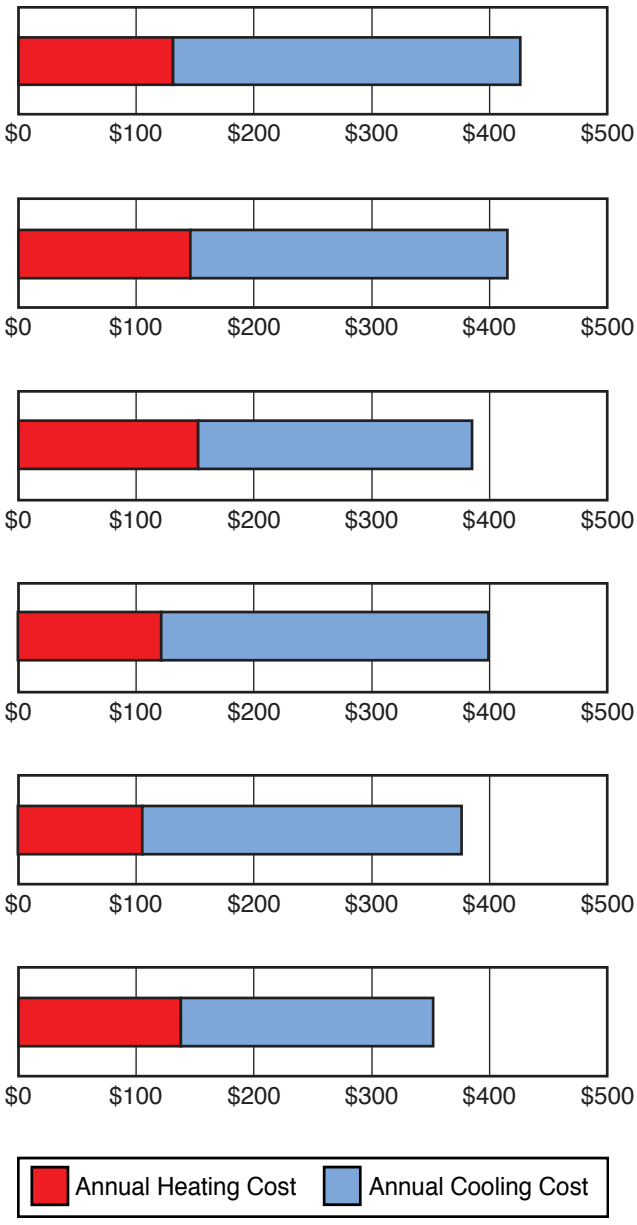
 **CASE 1** double glazing clear glass aluminum frame w/ thermal break	U = 0.63 SHGC = 0.62 VT = 0.62		Heating $131.90 Cooling $295.11 Total $427.01
 **CASE 2** double glazing tinted glass aluminum frame w/ thermal break	U = 0.63 SHGC = 0.52 VT = 0.47		Heating $146.70 Cooling $271.35 Total $418.05
 **CASE 3** double glazing low-E coating (low solar gain) argon gas fill aluminum frame w/ thermal break	U = 0.47 SHGC = 0.33 VT = 0.53		Heating $156.04 Cooling $226.43 Total $382.47
 **CASE 4** double glazing clear glass vinyl/wood frame	U = 0.49 SHGC = 0.56 VT = 0.58		Heating $120.28 Cooling $279.59 Total $399.87
 **CASE 5** double glazing low-E coating (high solar gain) argon gas fill vinyl/wood frame	U = 0.37 SHGC = 0.53 VT = 0.53		Heating $106.61 Cooling $271.62 Total $378.23
 **CASE 6** double glazing low-E coating (low solar gain) argon gas fill vinyl/wood frame	U = 0.34 SHGC = 0.30 VT = 0.50		Heating $139.41 Cooling $218.10 Total $357.51



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