Word On Windows
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Zero Energy Windows on the Horizon

In most existing buildings, windows are one of the weak spots when it comes to the energy performance of the building envelope. When temperatures outside are low, costly heat losses can occur through windows, which tend to have a far lower R-value than the surrounding walls. Moreover, windows are also the main culprit for overheating through sustained solar heat gain.

Thankfully, technological advances over the last 20-30 years have substantially improved the thermal performance of windows and thus reduced their contribution to heating and cooling loads to a reasonable level. Low-E windows with warm-edge spacers, for instance, reduce energy requirements by about 30-65 percent compared to conventional double-pane windows due to reduced heat loss and heat gain. But this is not where the technological potential for efficiency improvement ends: With emerging technologies and state-of-the-art design, buildings can be equipped with windows that balance out their contribution to energy demand with energy benefits such as controlled passive solar heating and daylighting. This technological potential can turn windows from being weak spots in the building envelope into enablers of low-to-zero energy buildings.

High Goals: Estimates of the technological potential

In a recent white paper, titled *Zero Energy Windows*, by Lawrence Berkeley National Laboratory and the U.S. Department of Energy, the authors lay out the potential for advanced window technologies to minimize or offset energy loss from residential and commercial fenestration.

Currently, windows in the United States are responsible for approximately 4.1 quadrillion BTUs of space conditioning energy consumption for both heating and cooling. This is more than 4 percent of total energy use in the US and costs building owners about $40 billion per year. Nevertheless, research and analysis as highlighted in *Zero Energy Windows* and other studies has identified substantial saving opportunities if emerging advanced fenestration technologies are successfully marketed and new high-performance products developed and commercialized.

Potential upgrade of existing U.S. building stock with near-future technologies		Annual savings potential
Residential	Combination of super-insulation (U-factor 0.10) with dynamic solar heat gain control	1.5 quads heating 0.75 quads cooling
Commercial:	Combination of super-insulation (U-factor 0.15) with dynamic solar heat gain control	1.1 quads heating 0.52 quads cooling
	Integrated façade design with enhanced daylighting capability	1 quad lighting
Energy impact of present window stock: 4.1 quads (ca. 60% residential, 40% commercial)		

The paper concentrates on the savings potential that can be tapped by retrofitting the existing building stock, both residential and commercial. The authors estimate that with the best available window technologies for high insulation and dynamic solar control this potential is roughly 2.75 quads. What is more, the authors identify technologies that could be developed in the near future and would more than offset the minimal energy loss they allow by controlled solar heating and enhanced daylighting. The table above lists the estimated potential of these future technologies.

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Zero Energy Window Prototype

The U.S. Department of Energy recently unveiled an example of a zero-energy window. See page 4 for more information.

I N S I D E

New U-factor specifications in the Northwest

On October 1, 2006, Bonneville Power Administration (BPA) put into effect new window specifications for their residential weatherization program. The Bonneville program does now require that the weighted average of all replacement windows installed in single family, multifamily and manufactured homes shall have a U-factor of 0.30 or lower. French and patio doors are exempt from this requirement and instead must meet ENERGY STAR criteria (U-factor 0.35 or better). Skylights are not included in BPA's weatherization program.

The new requirement is in effect for all utilities which receive assistance from BPA for their weatherization rebate programs. The specific incentives offered by these programs differ from utility to utility but they typically include a rebate of up to a few dollars per square foot of window replacement or low interest loans for the purchase of energy-efficient windows.

Due to the new specifications, we can expect to see a substantial rise in demand for windows with a U-factor of 0.30 or lower in the Northwest. The window market in this region already shows an exceptionally high market penetration of ENERGY STAR Windows (U-factor 0.35 or lower) and offers a range of products with a U-factor of 0.30 or lower. By pushing the latter market segment, the new specifications offer an incentive for manufacturers to focus on increasing the supply of their higher-performing products in the Northwest.

BPA service area

Window replacement boosts home resale value in Pacific region

New and efficient windows add a strong selling point to homes in the Pacific region. This is one of the findings of the Remodeling Cost vs. Value Report 2006, assembled jointly by the National Association of Realtors and the *Remodeling* magazine. Based on surveys among 2,188 realtors in 60 markets, the report projects average percentages of outlay recouped by home improvements, should the house be sold within a year. For window replacement with low-E windows this rate is highest in the Pacific region, where an average 96.6 to 99.2 percent of cost is recouped through a higher home resale value.

A summary of the report's findings is included in the January 2007 edition of the *Replacement Contractor*.

Portland real estate listing service will include energy-efficiency features

Starting early this year, the Regional Multiple Listing Service (RMLS) in Portland, OR will make it easy for house hunters to find energy efficient homes in and around Portland. The updated database on the RMLS web site will list energy efficiency features of homes, including energy-efficient windows and doors, to guide interested home buyers and real-estate brokers in their search for residences with lower energy consumption and less impact on the environment.

According to the Northwest Energy Efficiency Alliance's newsletter *NW Current*, the updated RMLS database will make Portland the first city to include energy efficiency information in its real estate listing. Currently, house hunters and real-estate agents can search homes in the online database by price, number of bedrooms, size, and so on. The ability to look for homes based on energy-efficiency criteria such as ENERGY STAR® appliances, efficient windows, or ENERGY STAR Home qualification will be a novelty.

The change in the online database is expected to not only increase demand among homebuyers for energy-efficient houses, but also to raise interest among homebuilders and remodelers to provide the demanded features. For more information, visit the *NW Current* web site at www.nwcurrent.com/efficiency/3957671.html.

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Low-E and ENERGY STAR® Windows in Florida

The energy performance of windows in new construction and existing buildings is vastly important in Florida, the state that ranks fourth in terms of population and first in terms of housing starts (U.S. Census Bureau data, 2005). It may therefore be surprising that low-E glass, arguably the most cost-effective technology for window energy performance, is still widely absent in the Sun State. The article below by the Consortium for Advanced Residential Buildings (CARB) explains why this is the case. In another article, we show an example of efforts to improve this situation: new ENERGY STAR Windows incentives by Progress Energy Florida, Inc.

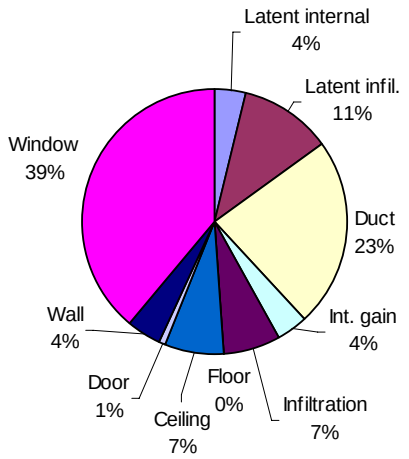
Understanding the cost of low-E

By the Consortium for Advanced Residential Buildings (CARB), a team lead by Steven Winter Associates

carb-swa.com

A home's windows can account for as much as 50% of the cooling load (see chart at left). Yet, low-emittance (low-e) windows are still not common practice in Florida. With Florida construction near record levels, the high cost of electricity for homeowners and the increasing peak load demand on utilities, low-e windows are the most economical energy measure available to address these issues. In most northern regions, low-e windows are standard or are available at a minimum cost increase (less than $1/ft^2 of glazing) to builders.

Summer design cooling load for typical 2,500 sq ft Florida home



So, why not Florida? It's not the actual cost of low-e coatings, but the upgrade from single- to double-pane windows. Lack of demand for insulated glass (IG) units has resulted in the slow market adoption of low-e windows. Although the money a builder saves in reduced HVAC tonnage can be applied against the cost of low-e coatings, it still may not cover the added cost of IG windows.

Where typical costs for just adding low-e coatings to window units may cost a builder $200 to $400, builders may see true costs of around $2,000+ for switching to IG, low-e windows. Many utilities are currently providing incentives for sealing ductwork, increasing insulation levels, and improving equipment efficiencies and the state is offering incentives for renewables. Though these are all beneficial, the real energy savings lies in reducing solar gain, and for that low-e windows should be the first consideration for incentive programs.

New ENERGY STAR® Windows incentive program by Progress Energy Florida, Inc.

On November 21, 2006, the Florida Public Service Commission approved Progress Energy Florida's request to expand their demand side management repertoire with a range of new programs, including new incentives for energy-efficient fenestration. According to estimates by the program planners, residential customers can reduce their energy consumption by up to 37 percent if they take advantage of all of the offered incentives in combination with Federal and State tax credits and loans for energy efficiency.

The new fenestration incentives include up to $250 per residence for ENERGY STAR® replacement windows. Window film and screens that control solar heat gain through east, west, and south-facing windows qualify existing residences and new construction for an incentive of up to $100.

In addition to fenestration incentives, incentives will be offered for reflective roofs, insulation, and energy recovery ventilation. Combined, these measures can significantly reduce cooling loads in new and existing homes. To assure that this energy-saving potential is leveraged, it is crucial to optimize and right-size the air conditioning equipment. To this end, Progress Energy Florida will also offer incentives for the proper sizing and optimal commissioning of high-efficiency air conditioners.

The new programs are expected to take effect in spring 2007. The Efficient Windows Collaborative will provide training to Progress Energy Florida representatives in order to assist with the practical implementation of the fenestration efficiency incentives.

For more information about Progress Energy's demand side management programs, visit www.progress-energy.com/save.

Updated EWC list of utility incentives for energy-efficient fenestration

On the Efficient Windows Collaborative web site, the EWC offers a list of utility programs that help home owners and builders finance more energy-efficient windows, window films, and window weatherization in 30 different states: www.efficientwindows.org/UtilityIncentivesWindows.pdf

This list was last updated in December 2006. As utility programs change and we come across new information about window-related utility programs, further updates and more detailed information will follow.

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While the paper concentrates on energy savings through window retrofits, advanced technologies will be equally crucial for enhancing the energy performance of newly constructed buildings. If optimal technologies and installation practices are utilized and climate-specific requirements taken into account, windows have the potential to become net-zero-energy building components. Technology and design developments crucial to realizing this enormous potential are:

- Highly insulating materials
- Dynamic glazing
- Daylighting materials
- Integrated façade design

The development and advancement of these options is supported by the U.S Department of Energy (DOE).

DOE's Emerging Technology Windows Program

Through its Emerging Technology Windows Program, DOE is supporting the emergence of window technologies that will offer the means to realize the energy savings potential described on page 1. The Emerging Technology Windows Program has two goals:

- Research and develop leapfrog technologies that will substantially improve the energy efficiency of window systems;
- Provide guidance and tools to encourage the widespread manufacture and use of emerging high-performance technologies.

Scientific research for the program is conducted by Lawrence Berkeley National Laboratory, while industry provides input and advises the program of its interests and priorities.

Particular emphasis is placed on promising next-generation technologies that could provide large savings but are too high risk or long term for industry to develop on its own. It is envisioned that in the not-too-distant future, these next-generation technologies will turn windows into net-zero-energy building components and eventually into net energy providers.

The table below shows a timeframe for technical targets for three technologies that the Emerging Technology Windows Program is focusing on: dynamic solar control glazing, highly insulated windows, and daylight-redirecting glazing.

Constant technical progress is bringing window technologies closer to the targets given in this table. However, not only technical capabilities, but also the market for these technologies will have to be developed further, which can only be achieved through concentrated efforts by government, the fenestration and building industry, and utility programs.

Technology	Characteristics	2007 Target	2010 Target	2015 Target	2020 Target
Dynamic Solar Control	SHGC	0.50-0.10	0.53-0.09	0.53-0.09	0.53-0.09
	Visible Transmittance	0.60-0.04	0.65-0.03	0.65-0.02	0.65-0.02
	Size (sq ft)	16	20-25	>25	>25
	Incremental cost/sq ft	$50	$20	$8	$5
Highly insulating	U-factor	0.20-0.25	0.17	0.10	0.10
	Incremental cost/sq ft	$5	$5	$4	$3
Daylight redirecting	Lighting energy savings	50%	50%	60%	60%
	Perimeter zone depth (ft)	15	20	20	30
	Incremental cost/sq ft	$8	$8	$6	$6

Source: U.S. DOE Energy Efficiency and Renewable Energy Multi Year Program Plan www.eere.energy.gov/buildings/about/mypp.html

The white paper *Zero Energy Windows* by Arasteh et al. can be accessed at www-library.lbl.gov/docs/LBNL/600/49/PDF/LBNL-60049.pdf

Zero Energy Window Prototype Introduced

The above article discusses the big picture of how zero energy windows can enhance U.S. energy performance. A more concrete example of what the future holds has recently been unveiled by the U.S. Department of Energy (DOE): a zero energy window prototype, developed in partnership by Lawrence Berkeley National Laboratory (LBNL) and SAGE Electrochromics, Inc. (Faribault, MN).

Unlike many other building components, windows have the potential to be net providers of energy. That is, if heat loss is minimized, while solar heat gain is allowed in times of heating demand and blocked in times of cooling demand. With this in mind, the window prototype presented by DOE has been developed to be both highly insulating (U-factor 0.18) and to offer dynamic solar control (SHGC 0.04 to 0.34). The low U-factor is achieved with a combination of design elements that only slightly increase the weight of the window:

- an acrylic non-structural center layer, serving as a thermal barrier between the two window panes;
- high solar gain low-E coating;
- a wood and fiberglass frame;
- 95 percent krypton gas fill.

Dynamic solar control is provided by SageGlass® electrochromic glazing on the outer pane. This glazing consists of multiple metal oxide coatings on glass.

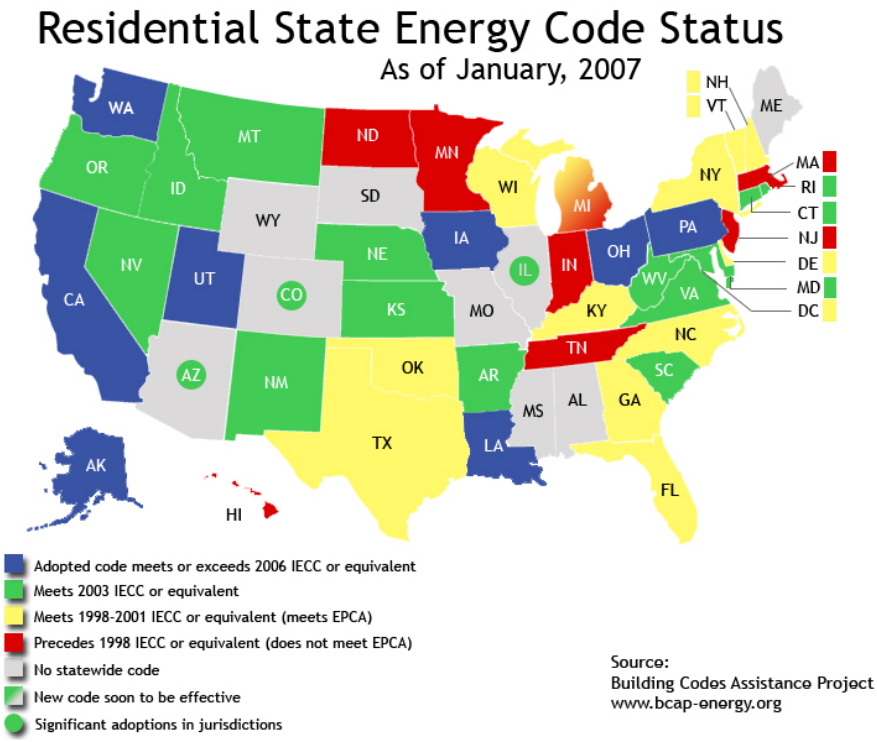
This prototype can serve as a zero energy window in many U.S. climates and is a significant step forward to DOE's goal of developing a zero energy window for all climates. As DOE Assistant Secretary of Energy Efficiency and Renewable Energy, Andy Karsner, said, "DOE is investing in research to develop and commercialize the products of tomorrow, such as this next generation window, so that by 2020 we can build homes that are zero net energy".

For more information, view DOE's press release: www.energy.gov/news/4501.htm.

2006 IECC adopted by several states

With the beginning of 2007, window energy provisions are changing in several states as they update their building energy codes to the 2006 version of the International Energy Conservation Code (IECC). This code was published by the International Code Council (ICC) in early 2006 and has now taken effect in the first states and jurisdictions. The standards and provisions for residential windows in the 2006 IECC differ from those in the 2003 IECC and older model energy codes.

The 2003 IECC had so far been the most recent model energy code version adopted by states, although many have yet retained older model energy codes such as the 2000 IECC or the 1995 Model Energy Code, while a few states have no state-wide building energy code at all. Some of the states adopting the 2006 IECC had fairly old previous residential energy codes, such as Iowa (1992 Model Energy Code) or New Jersey (1995 MEC). Most other states had their previous energy codes based on the 2000 or 2003 IECC.



Where is the 2006 IECC in effect or adopted (as of January 2007)?

Effective: *IA, LA, PA, UT.* On New Years Day 2007, the 2007 IECC went into effect in Iowa and Utah, after it had become effective in Pennsylvania the day before. Simultaneously, Louisiana brought into effect the 2006 International Residential Code (IRC), which provides residential energy conservation standards similar to the 2006 IECC in its Chapter 11.

Adopted: The 2006 IECC has also been adopted and will become effective soon in Ohio and Alaska (AK: residential provisions only). New Jersey, Kentucky and South Carolina are approaching adoption of the code. Several other states, with Georgia and Indiana being just two examples, are actively considering adoption of the 2006 IECC. Notable exceptions are the three West Coast states, which all have their own stringent home-grown building energy codes.

For more information on the code adoption status in states across the nation, visit the website of the Building Codes Assistance Project: www.bcap-energy.org.

The residential window requirements of the 2006 IECC differ substantially from those in the older model energy codes (the 1998, 2000 and 2003 IECC or the 1992 and 1995 MEC). These differences are relevant to all states that upgrade to the new code.

Residential window requirements that differentiate the 2006 IECC

The residential window provisions of the 2006 IECC provide simple prescriptive standards that basically require the use of low-E glazing in all climates. These standards are independent from the size of the glazing area relative to the wall area. This is the most obvious difference between the 2006 IECC window provisions and those of the older model energy codes, in which the window-to-wall ratio determines the U-factor requirements for new construction. The simple prescriptive requirements of the 2006 IECC make the new code easier to use, thus increasing the chances for correct compliance, which generally means the use of NFRC-certified low-E glazing.

The elimination of window-to-wall area considerations also provides opportunities for larger window areas. In order to assure that large window areas do not impede too much on building shell energy performance, the 2006 IECC includes maximum U-factor and SHGC tradeoff limits. Therefore, although builders are provided flexibility in reaching overall performance requirements by trading among different building components, they may not trade down window performance beyond fixed limits that depend on the climate zone. These limits further strengthen the role of low-E glazing as a means to comply with the code.

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Another significant difference is that, whereas the provisions for glazing in new construction in the older model energy codes differed from those for window replacement, the 2006 IECC requires the same performance levels for either. Again, this serves to simplify the code. It also means that, in any given climate zone, there is only one set of performance criteria that windows must meet – both for retrofits and new construction.

By upgrading to the 2006 IECC, states are adopting residential window requirements that are easier to use and that make it harder to trade away low-E glazing. If this is accompanied by effective code enforcement in both new construction and retrofit applications, it will further strengthen the role of low-E glazing as a technology that is among the most cost-effective ways to enhance building performance and to meet state energy codes.

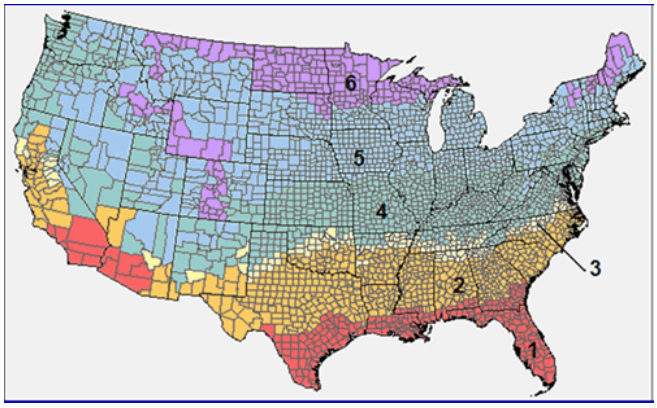
Prescriptive window requirements in the 2006 IECC

Climate Zone	Fenestration U-factor	Skylight U-factor	Fenestration SHGC
1	1.20	0.75	0.40
2	0.75	0.75	0.40
3	0.65	0.65	0.40
4 except Marine	0.40	0.60	no requirement
5-8 and Marine 4	0.35	0.60	no requirement

Maximum area-weighted U-factor and SHGC allowed through tradeoffs in the 2006 IECC

Climate Zone	Fenestration U-factor	Skylight U-factor	Fenestration SHGC
1-3	N.A.	N.A.	0.50
4-5	0.48	0.75	N.A.
6-8	0.40	0.75	N.A.

Climate zones in the 2006 IECC



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Do You Have News You'd Like to Share?

We're always interested in reporting on new developments in the residential and commercial fenestration markets. If you have something you would like to share with us please contact Nils Petermann at: npetermann@ase.org.

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