U.S. Department of Energy
Energy Efficiency and Renewable Energy
Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

Zero Energy Window Prototype

HIGH PERFORMANCE WINDOW OF THE FUTURE

Background and Performance Objective

Today's energy-efficient windows with low-e coatings are vast improvements over the standard window that was sold just 25 years ago. But windows are still responsible for over 4 quads of annual energy use costing building owners around $40B per year. Unlike many other building components, window losses can be reduced to zero with improved technology and better design. In many cases, windows can become net providers of energy to buildings, adding solar heat in winter and daylight to offset electric lighting year round. In order to convert the thermal losses to net gains, two major improvements are needed in window properties. The thermal loss characteristics, or U-factor, of windows must be reduced from today's levels of 0.35 - 0.5 BTU/h-ft^2-F to levels of 0.1 - 0.15 BTU/h-ft^2-F. At the same time, the strategy for optimal control of solar gain varies with season and climate in the U.S. Rather than argue over a high or low solar heat gain coefficient (SHGC), the year-round, all-climate solution is a variable SHGC that can be changed over a wide dynamic range. Supported by extensive simulation studies undertaken at the Lawrence Berkeley National Laboratory (LBNL) and in collaboration with industry, the Department of Energy (DOE) has set technical targets for the development of high performance windows. The long term goal for SHGC, for example, is for a range from 0.53 to 0.09.

THE NEXT GENERATION
Highly insulating with dynamic SageGlass® glazings.

Properties for the 2006 Highly Insulating Dynamic Prototype

Property	Center-of-Glass	Whole Window
U-factor (Btu/h-ft^2-F)	0.12 (R 8.3)	0.18 (R 5.6)
SHGC	0.05 < > 0.36	0.04 < > 0.34
Visible Transmittance	0.03 < > 0.56	0.01 < > 0.49

A Concept Window For New Markets

Although high energy prices and growing concerns about energy availability, energy security and carbon emissions have led to increased interest in high performance windows, the market drivers are not yet in place to energize mainstream manufacturers to invest and develop a new generation of high performance products that leapfrog current solutions. Accordingly, the DOE has undertaken several R&D projects

For more information regarding the windows program, see www.govforums.org/e&w or contact Marc LaFrance at 202-586-9142, marc.lafrance@ee.doe.gov

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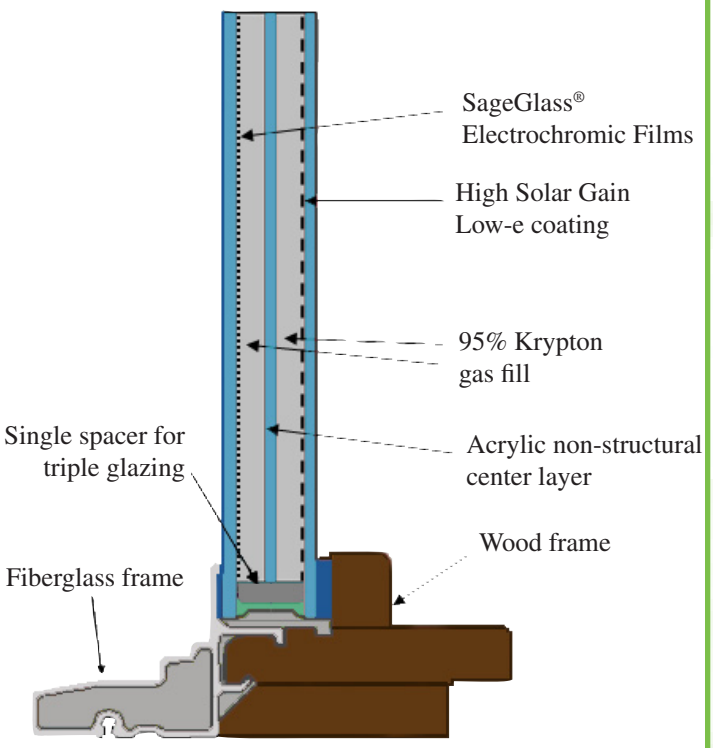

Highly Insulating, Dynamic Window Prototype

This prototype makes two significant departures from existing mainstream window systems. In order to reach U factors significantly below 0.3, one must abandon a conventional low-e, gas filled double glazed system, and switch to either vacuum glazing, aerogel, or a multilayer window system. Based on the desire to develop a prototype at affordable cost and one that could build on existing industry manufacturing capacity a three layer window was selected, with commercially available low-e technology and krypton gas fill. A rigid center plastic layer is added as a low-cost convection barrier, and a wood/fiberglass combination frame is used. Finally, the dynamic solar control (and second low-e) is provided using SageGlass® electrochromic glazing as the outboard lite. SageGlass® electrochromic glazings consist of multiple metal oxide coatings on glass. This prototype is a Zero Energy Window in many U.S. climates and better than half-way to our ultimate goal of being a Zero Energy Window in all U.S. climates. See the figure to the left for the prototype window schematic.

to develop the needed component technologies, e.g., switchable glazing, and to integrate and optimize R&D needed to produce concept windows that will form the basis for the next generation of windows. Although the "concept window" is not intended for production, these prototypes are being developed with an eye toward future manufacturability and affordable cost. Additional simulations and field tests are planned to further demonstrate the performance of these prototypes, not only in terms of energy savings but in terms of other marketable features, e.g., comfort, peak load reduction, glare control, etc. While the initial prototypes are developed with residential applications in mind, the underlying technologies are applicable for residential and commercial applications, and for retrofit as well as new construction. This should generate additional information on the demand side as well as the supply side for this new technology.

National Fenestration Rating Council®
CERTIFIED

Carbon-Neutral Building Products Co.
Zero Energy Window Prototype
Fiberglass/Wood Combination Frame
Triple Dynamic Glazing • Krypton Fill • Low E
Product Type: **Casement**

ENERGY PERFORMANCE RATINGS

U-Factor (U.S./I-P)	Solar Heat Gain Coefficient
0.18 (On) ↔ 0.18 (Off) Variable	0.04 (On) ↔ 0.34 (Off) Variable

ADDITIONAL PERFORMANCE RATINGS

Visible Transmittance	Air Leakage (U.S./I-P)
0.01 (On) ↔ 0.49 (Off) Variable	

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.
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sample only
not NFRC certified

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Ernest Orlando Lawrence
Berkeley National Laboratory

SAGE ELECTROCHROMICS, INC.

For more technical information, visit
http://windows.lbl.gov